CD-ROM!

The Naked Truth & Killer Animations

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- Installing & Configuring a CD-ROM Drive
- Video, Animation, and Sound
- CD-ROM Formats
- Learn CD-ROM Speed Secrets

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Harald Hahn

DATA BECKER EDITION

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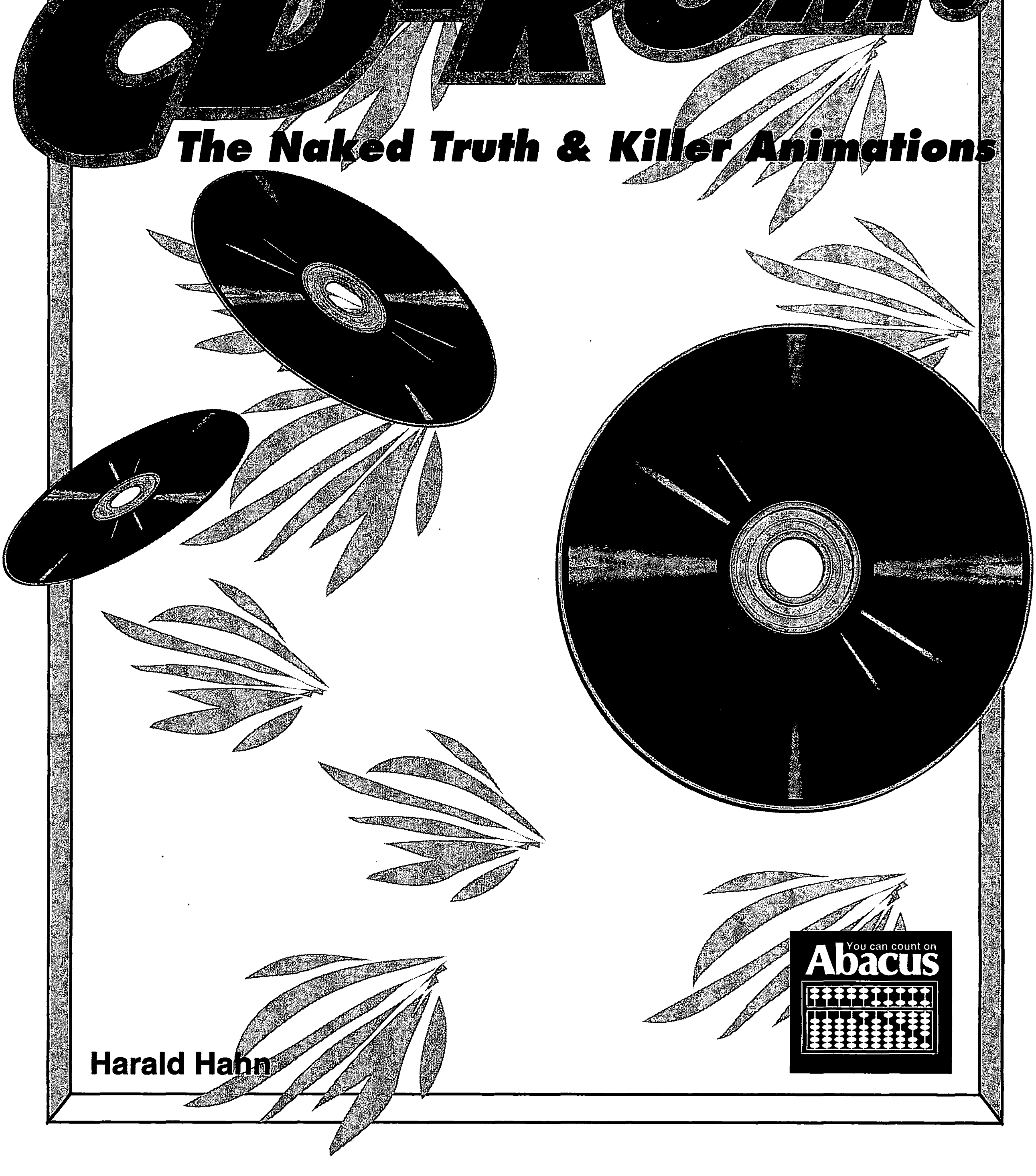
CD-ROM!

The Naked Truth & Killer Animations



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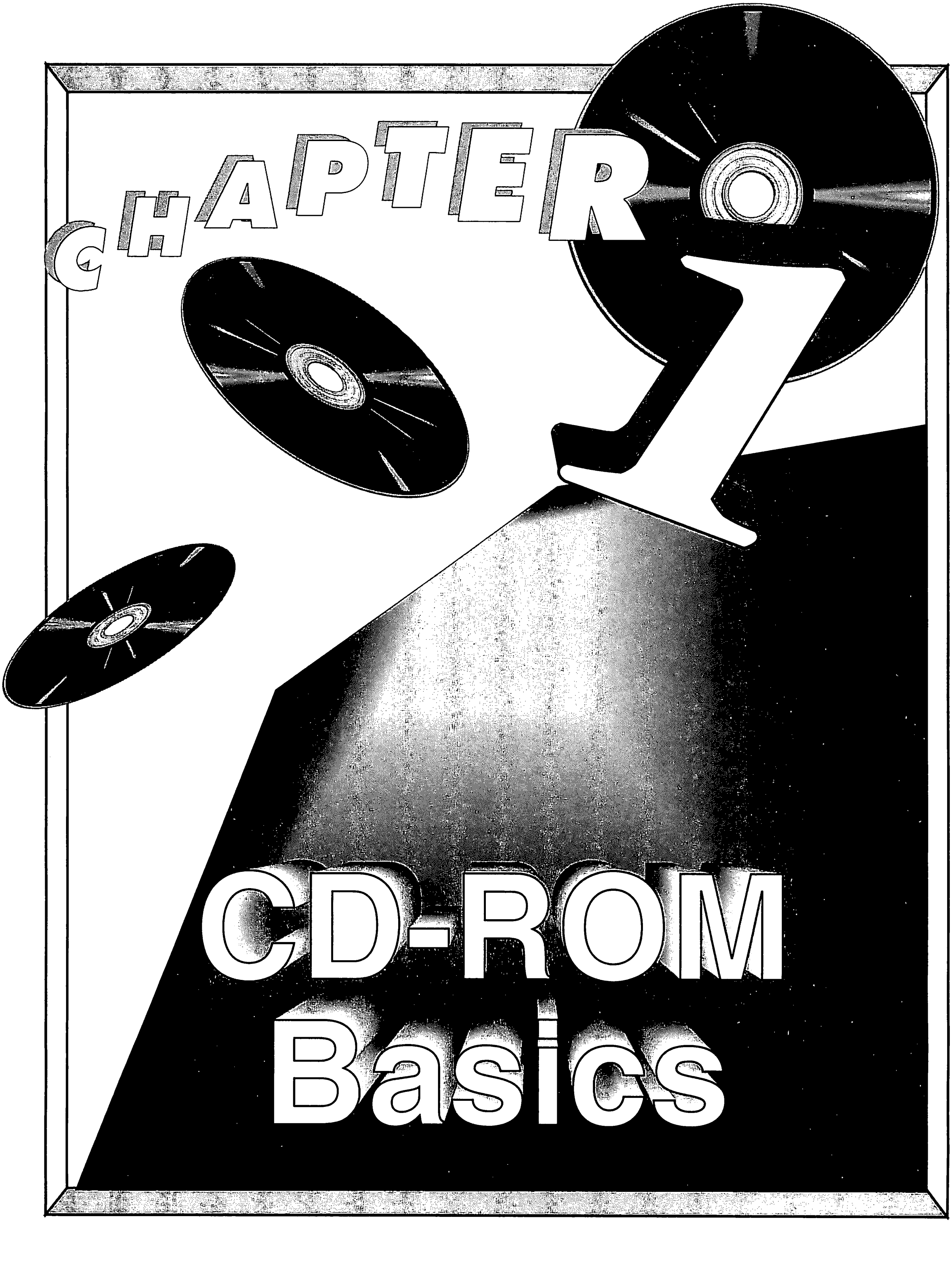
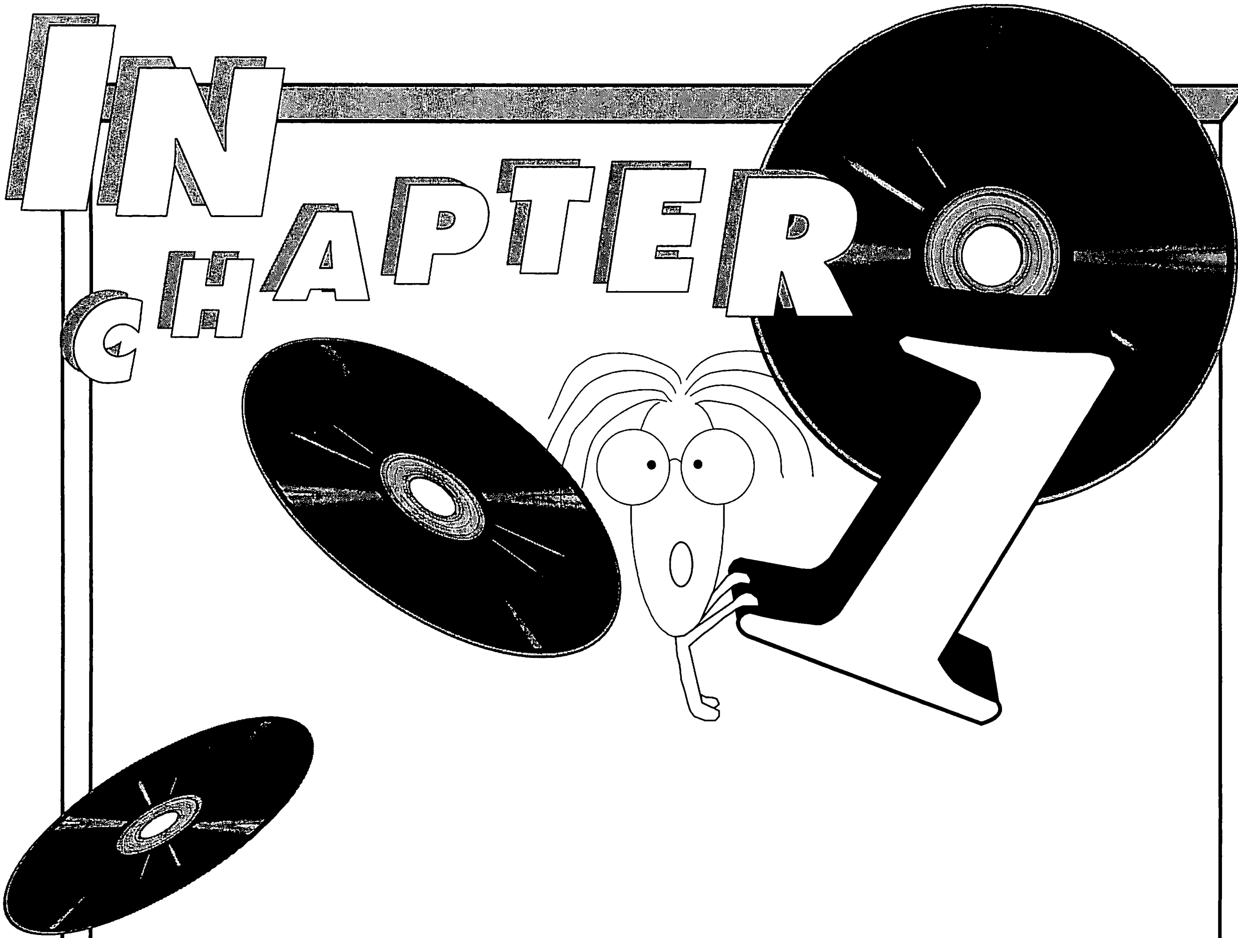
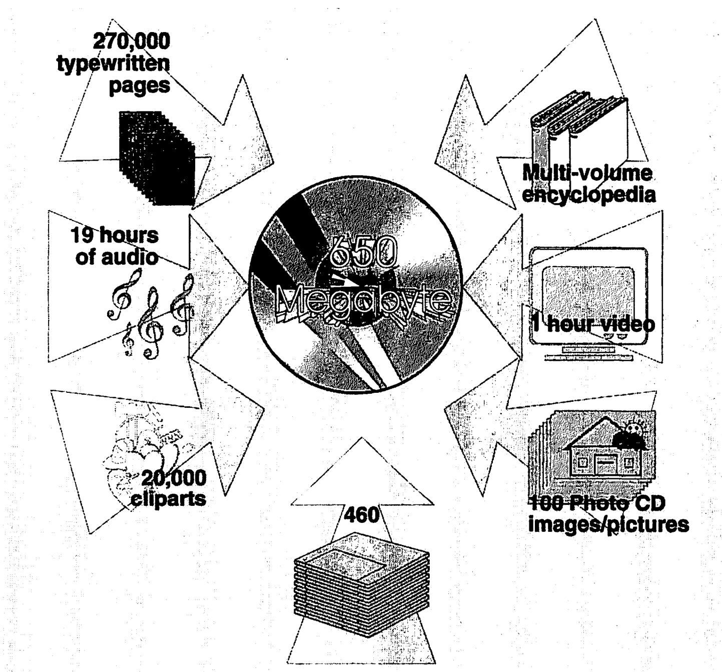



IN CHAPTER 1

1 CD-ROM Basics 1

The basic technology for using CD-ROM on your computer is borrowed from the audio CD world. One part includes the term "compact disc" or its abbreviation CD. The ROM part of the name is an acronym for Read Only Memory. In its basic version, a CD-ROM for a computer is strictly a read-only medium. Therefore, you cannot write to a CD like you can a floppy diskette or your hard drive.

The following illustration shows the tremendous storage capacity of the CD-ROM:



The capacity of a CD-ROM

Chapter 1

CD-ROM Basics

The following table shows the advantages you have by using a CD-ROM:

High storage capacity	Up to 650 Meg of data on a plastic platter that's about 5 inches in diameter
Portability	Portable and replaceable medium
Standardization	Industry-wide recording formats
Data cannot be changed	Strictly read-only
Sturdiness	Durability much greater than that of other magnetic media such as 5 1/4" and 3 1/2" floppies.
Reasonably priced	Low manufacturing costs
Additional options	Audio capable, special compression of audio, image and video data

Recently, recordable CDs have also become more popular. We really cannot refer to these as CD-ROMs since they're not ROMs. Instead, we have Compact Disc Recordable (called CD-R). We can divide recordable storage media, which are essential for some applications, into two categories:

1. Media that can only be written to once.
2. Media that can be written to several times. However, the magneto-optical drive (MOs) technology used here is quite different from the original technology.

The number of existing CD-ROM standards and available drives make it confusing to understand all there is to know about CD-ROM drives. The idea of simply choosing a CD-ROM drive to be able to read and use CDs can quickly become frustrating. In many cases, you're asked to determine the difference between a drive costing a few hundred dollars and one costing over a thousand dollars.

We'll help you determine what those differences are in this chapter. We'll discuss possible uses for CD-ROMs, their operation, and the current standards for drives and ports.

A History Of CDs

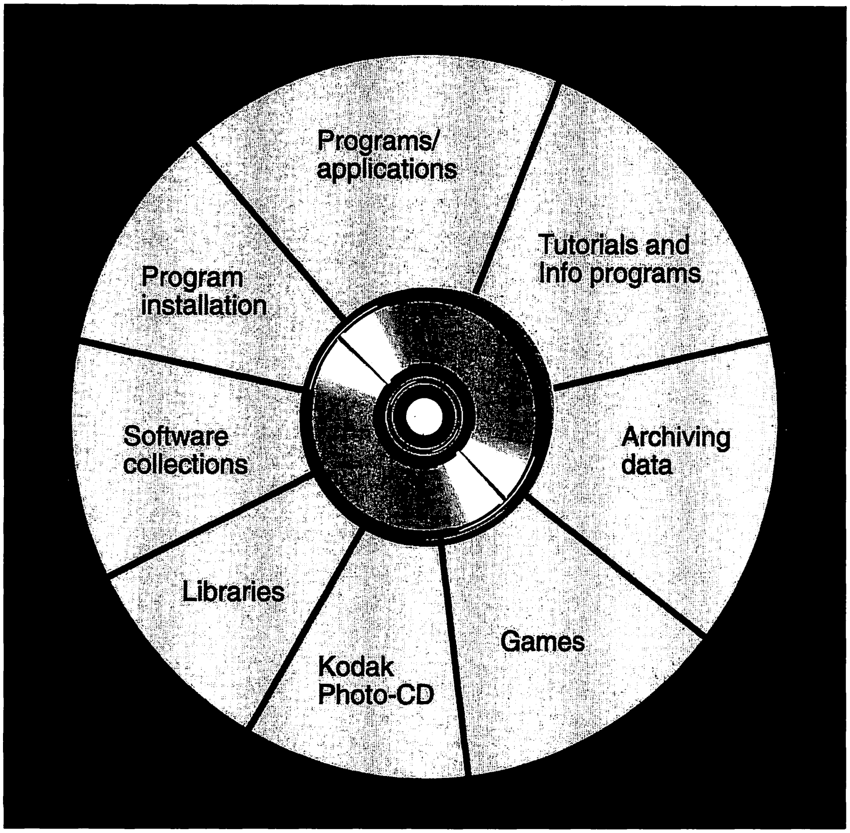
The following table highlights the history of the CD-ROM technology:

1979/1982	*Audio CD*	The audio CD is released. It becomes such a large competitor to the record album that today few "record" companies actually release albums ("LPs") but instead use audio CDs.
1985	*CD ROM*	The CD is adapted to the computer world and called a CD ROM. However, initial interest is slow; software developers are slow to release applications on CD ROM because the hardware is too expensive for general use.
1989/1991	*CD ROM/XA*	The CD ROM standard is enhanced. Multimedia requirements for hardware are specified.
1992	*Photo CD*	The Kodak Photo CD lets users store conventional photo images on CDs. Meanwhile, the photo CD, which is somewhat different from the XA standard, has developed into a world-wide recognized standard.
	CD-I	The CD-I (CD Interactive) is aimed at the entertainment branch of users. By means of a CD-I player, which can be directly connected to a television set, you can read playback CDs.
1993	*3DO, CD32, Sega MegaDri*	3DO and CD~32 are two platforms from the home electronics world. 3DO was designed for games and presentations; CD~32 and Sega MegaDrive are strictly game consoles. In the years to come you can expect about three new game platforms per year.
	Video-CDs	A new standard is established, enabling users to achieve quality video playback on the PC for the first time.
1994	*Hardware*	Prices for CD-ROM drives fall below $200 which makes them affordable for all PC users. Thousands of CD-ROM software titles are available.

CD-ROM Applications

While a CD-ROM drive is an optional peripheral for a PC, it's a requirement for a multimedia PC. With the drastic decrease in the price of CD-ROM drives, they're becoming almost standard equipment on all today's PCs.

CD-ROM Basics



The main areas of application for CD ROM drives

Installing programs from CD-ROM

Many of today's complex programs and powerful operating systems, like OS/2 2.1 or Windows NT, require as many as 30 installation diskettes. It's no wonder that CD-ROMs are frequently used as a distribution medium. This allows you to install programs and applications stored on a CD-ROM to your hard drive. You'll save yourself the trouble of having to change diskettes constantly when you install the program. Another advantage of using CDs for distribution medium is their dependability: Read errors seldom occur. Also, there's no need to create a backup copy.

The first program to appear on CD-ROM was CorelDRAW! Version 3.0 from Corel Systems Corporation in Canada. Now many more applications are distributed on CD-ROM; a few applications are offered exclusively on CD-ROM.

We can't forget about collections of shareware on CD-ROM. This method of shareware distribution has become a very important way to move "try before you buy" software into users hands. Individual shareware programs are copied from the CD to your hard drive, and then installed from there. The convenience of this method of distribution of shareware will undoubtedly become very popular.

The CD-ROM as a database

The early use of CDs was to save time and trouble installing large applications or operating systems from several distribution diskettes. Later applications took advantage of the huge storage capacity of the CD-ROM. These applications let the user access large amounts of data.

More recent programs have been released which allow the home computer owner to access a wide variety of large databases. These collections include encyclopedias, bibliographies, phone directories, zip code information and more. It's very easy to access the CD-ROM database; all you need to do is insert the appropriate CD into the drive. You can then use selected files or transfer them to your hard drive.

Using a CD to access a large database or other large collection of data does not make any great demands on your hardware; you can even use an older CD-ROM drive, although a slower processing speed may affect the time required to access data.

Photo-CDs

By using a Photo-CD, you can modify, edit, and perform other work on your photographs using your PC. The Photo-CD system, introduced by Kodak in 1992, stores conventionally processed color photographic images in digital form on a CD called a "Photo-CD". You drop off your photographs at the photo shop as usual. But instead of pictures, you receive a CD-ROM containing digital representations of the photographs.

Currently you can store up to 100 images on a Photo-CD. If you have a Photo-CD capable drive and the right software, you can then display the images in different resolutions and manipulate them. In this way you can digitize conventional images, including photos, slides or paper documents, and use them in desktop publishing, business or personal letters, or other electronic image communication. Photo-CDs are becoming more popular in creating presentations.

In addition, users can display images on a normal television using a Photo-CD player. The Photo-CD makes it possible to link three different media: photography, television and PC.

All in all, the Photo-CD has already become an important standard which is attracting an increasing amount of attention.

CD-ROM Basics

There are special hardware requirements for processing Photo-CDs. Although most CD-ROM drives sold today conform to these requirements, make certain before purchasing a lower priced drive or used drives that it can be used with Photo-CDs.

Professional use of CD-ROM libraries

There are also professional libraries on CD-ROM. The difference between regular databases on CD-ROM and libraries is that you access the libraries interactively, for example during your regular work on the computer creating presentations.

Examples of libraries are font libraries, clipart libraries, and multimedia libraries featuring sound collections and video clips. Interactive access such as creating a presentation requires that the CD-ROM drive have adequate processing performance.

Programs on CD

Starting programs directly from a CD also places great demands on a CD-ROM drive. In this case, the program files and modules remain stored on the CD-ROM and do not affect the hard drive. The first company to use this method was Corel Systems Corporation with their CorelDRAW! graphics program. You can choose between installing the complete program on the hard drive or transferring a minimum number of necessary configuration files to the hard drive and load the program from the CD.

More recent programs now also offer different levels of installation which let you select how many files will remain on the CD-ROM and how many will be copied to your hard drive. You can save large amounts of hard disk space by selecting the files you want to install instead of installing files which you may never use. However, make certain your CD-ROM drive has a high enough processing speed.

Games on CD-ROM

A CD-ROM is a wonderful medium for games and entertainment programs. You don't waste any valuable hard disk space when you run the games from the CD. On the other hand, running games from the CD does place considerable demands on the hardware concerning data transfer rate, graphics/video display and sound.

In addition, special platforms are available for running games from CDs. These are systems with special playback devices whose CDs are not compatible with conventional CD-ROMs. In 1993 two new game consoles from the home electronics boom were introduced:

1. 3DO has several serious applications.

2. CD32 from Commodore is strictly a game console.

We expect that other platforms will soon follow suit.

Training and tutorials

Training and tutorials are another promising area for CD-ROMs. These programs have been available mainly on diskettes until recently. However, the large storage capacity of the CD allows animation, sound and video sequences to be easily integrated into the training material.

As CD-ROMs become more commonplace, we'll see CBT (Computer Basic Training) take off.

We're starting to see cooking tips, do-it-yourself techniques, home and auto repair, and many other topics on CD-ROM. These programs won't just be multimedia, i.e., using sound, image, video and animation sequences, but also interactive whereby your participation changes the information that is displayed.

Naturally, CD-ROMs could also be used as storage media, for example, as a travel guide with information about a city, state, or region of the country. A CD-ROM could replace or enhance a user manual: Running an interactive animation through a CD can be easier to follow than reading a large technical manual.

POI (Point of Information)

In commercial information systems, you hear the terms POI (Point of Information) and POS (Point of Sale). Systems consisting of a monitor and a keyboard, which you use to access a CD-ROM player, for example, are called terminals. Terminals for information are called POI, while terminals dealing with sales are referred to as POS.

Terminals, for example in a travel office, where you can get information about a travel destination interactively. You might find such terminals not only in travel agencies, but also at train stations and airports.

POS (Point of Sale)

Self service terminals, which customers can use to inform themselves about specific products.

If these information systems come equipped with CD-ROMs, it stands to reason that these are in low to minimum circulation. That brings us to another use for CD-ROMs: Recordable CDs.

Storing data on CD

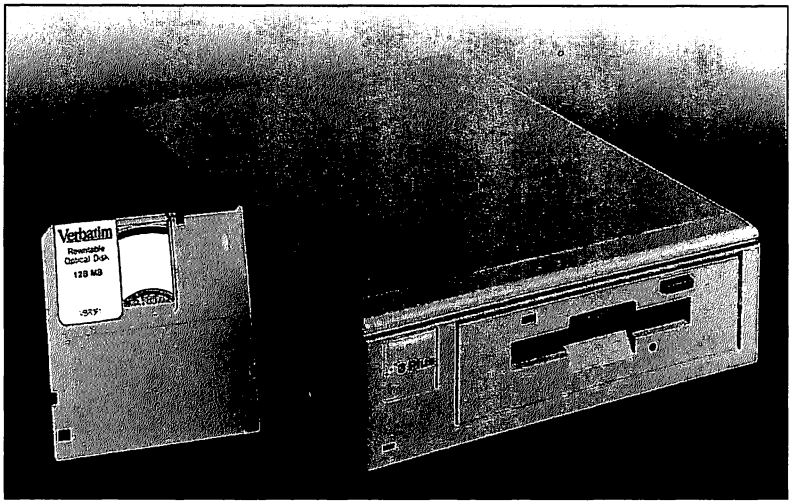
For some users, the CD is becoming more important as a recordable medium. Here's a quick look at this method.

CD-ROM Basics

The first type of recordable CD was the WORM CD (Write Once - Read Many Times). These CDs, which have a capacity of 128 Meg in a 3.5-inch format and 650 Meg in the 5.25-inch format and are supplied in cartridges, can be recorded exactly once.

This technology has been superseded by two other developments:

1. The CD-R technology. It can only be recorded once but can be read like a normal CD in any CD-ROM drive. CD-Rs can be used for data archiving, as storage media or even as master discs.
2. The magneto-optical technology. These drives, called MO-CDs (Magneto Opticals), are also in cartridges. The special advantage of this technology is the storage media can be recorded several times. However, unfortunately, these CDs do not follow the CD-ROM standard. Capacities of 128 Meg for 3.5-inch drives and 650 Meg for 5.25-inch drives are possible.



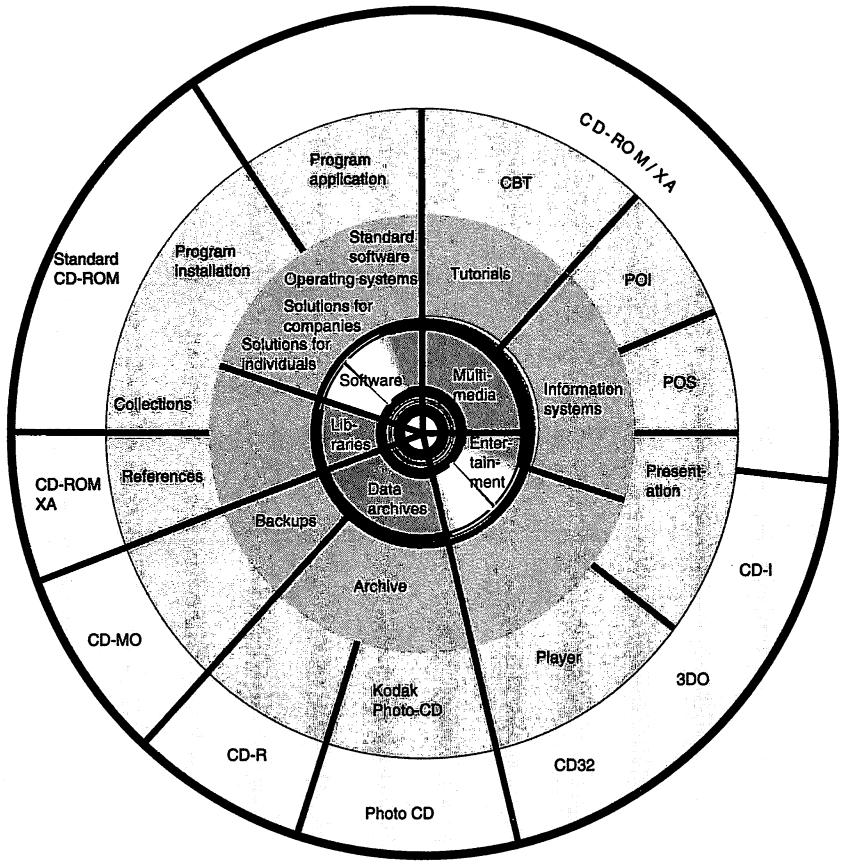
A typical MO-CD (Magneto Opticals) drive

Application oriented CD-ROM standards

The following illustration summarizes the different standards. Proceeding from the five basic areas of software, libraries, multimedia applications, entertainment and data archiving, several application areas have been classified. A CD system has been assigned to each of these areas of usage. The technical backgrounds and features are shown for each system.

CD-ROM Basics

Areas of Usage and Standards



Standard CD-ROMs

These are simple, conventional CD-ROM drives which only have to meet the MPC standard. An MPC system is a multimedia PC, or a PC equipped with multimedia components (CD-ROM drive, sound card, speakers, etc.) whose hardware meets specific requirements for processing speed. The MPC standard was developed by Microsoft in cooperation with other companies and is supposed to guarantee that multimedia applications will run on all MPCs without restrictions. You can find the MPC definition in Chapter 3.

CD-ROM/XA and the Kodak Photo-CD

CD-ROM/XA is an extension of the CD-ROM standard. Aside from some minor improvements, these drives usually also have a much higher processing speed than standard CD-ROM drives.

To be able to read Kodak Photo-CDs, the drive must be Photo-CD compatible.

Recordable once - the CD-R

The CD Recordable is a CD that can be recorded once. The blank CD media can be recorded once in a CD Writer and subsequently read by a conventional CD-ROM drive.

Multiple recordable - the CD-MO

CD Magneto-Opticals are magneto-optical storage media that can be recorded several times. However, CD MOs are not compatible with CD-ROM drives.

CD-I, 3DO, CD32

All three systems are intended for the home electronics market. These systems are specially designed for games and digitized videos. It's not likely these systems can be used with a PC.

CD Standards For PCs

You may have seen or heard terms such as High Sierra/ISO 9660, Red Book, Yellow Book, and many others when discussing CD-ROM standards.

Today's standards for CD-ROMs actually began with the standards applied to audio CD. To help the audio CD gain acceptance with consumers, standards were established early in its development. The adoption of CD technology in the computer world was also standardized early. The standards were called Red Book, Yellow Book, Green Book, or Orange Book. The colors referred to the color of the laser light used in the CD-ROM drive. The complete collection is called the *Rainbow Books*.

Other colors in the collection include the White Book and the Blue Book. The contents of the Blue Book will depend on the continuing development of the blue laser. The blue laser promises a new higher density of 6.5 Gigabytes on a standard CD. However, the necessary technology will not be ready for production for a few years.

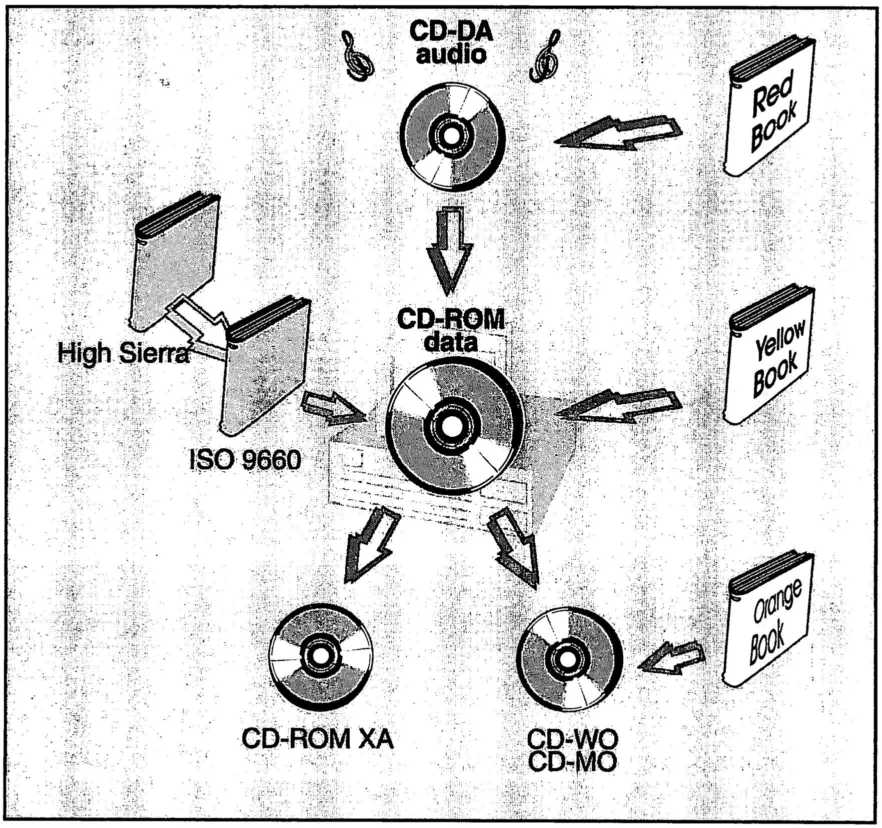
The origin of CD-ROM technology begins with the audio CD. The recording format for audio CDs is defined in the Red Book. The CD-ROM was developed when this storage medium was applied to computers. The standards for CD-ROM are defined in the Yellow Book. At a higher level, standards affecting file structure were then added, these standards are called High Sierra or ISO 9660.

CD-ROM Basics

The CD-ROM/XA is an extension of the conventional CD-ROM; it also refers to specifications from the Yellow Book. In addition, there are recordable CDs available, CD-WO and CD-MO, whose specifications is defined in the Orange Book.

All CDs are standardized by the High Sierra/ISO 9660 standard and in the Rainbow Books. To a certain degree, the Red, Yellow and Orange Books determine the physical size of recording. For example, these books specify the sector size to be 3,234 bytes. The logical size of data recording is specified in the High Sierra/ISO 9660 standards.

For example, these standards include definitions which specify the arrangement of data in files and directories. So, you have the advantage of files and subdirectories on CD-ROMS like you do in DOS. This is very practical because at a later time it's only necessary to define the interaction between the ISO 9660 standard and the operating system. The programs that handle the transfer of data from the hardware to the operating system are called *drivers*. As there are printer drivers and video drivers, you will also need drivers for CD-ROM drives.



CD standards

CD-ROM Basics

Audio CD

The acronym CD-DA refers to the conventional audio CD. The "DA" is an acronym for digital audio. Philips and Sony established the specification for audio CD in the Red Book in 1982.

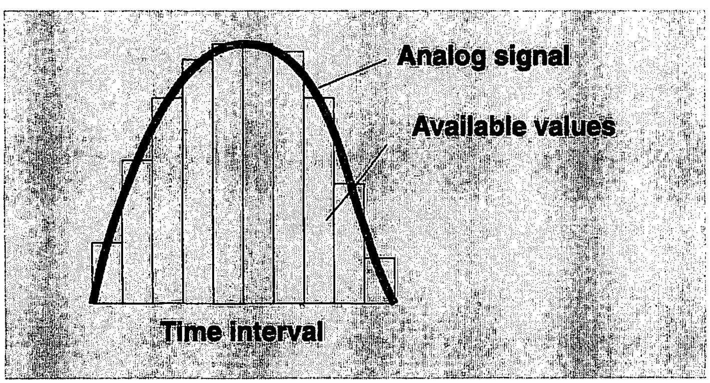
A single sector contains a total of 3,234 bytes, of which 2,352 can be used for storing music. The other bytes are used for error detection and correction.

CD-DA sector partition

On an audio CD, 75 sectors per second are read. These 75 sectors contain a total of 75 x 2,352 = 176,400 bytes. That means 176,400 bytes per second are read.

This number specifies a value which will become more important with CD-ROMS. This becomes the data transfer rate, that is, how many bytes per second must be transferred from the CD. In this case, the data transfer rate is 176,400 bytes/second, or 172K/second.

In moving from LP records to CD-DA, the industry changed from analog to digital recording of musical data. Technically, analog recording means that a music signal is passed at varying voltage levels. With digital recording only discrete numeric values are stored. When analog input signals are assigned specific numeric values, we call it *sampling*.



The digitizing process

In sampling, two factors play an important part in the quality of the digital recording. One factor is how often the values are measured from the analog voltage level. The other is how many different values are available for coding. The first issue has to do with the *scanning frequency*. The scanning frequency for

an audio CD is 44.1 kHz, i.e., the signal is measured in constant intervals 44,100 times per second. The number of available values is 2^{16} (2 to the power of 16) or 65,536. Since the number is 2^{16}, we also speak of 16 bit coding

Reading 75 sectors per second from the CD is exactly enough to represent the information required for a piece of music sampled at 44.1 kHz using 16 bits.

The procedure used to sample the music is called PCM for pulse code modulation. Each musical piece is stored in a track.

CD-ROM

Reading computer data was not covered in the Red Book for audio CD. Philips and Sony standardized the storage of computer data for the first time in 1985 in the Yellow Book.

The technology used to store the physical data on a CD is the same for either digital audio data and computer data. This means that a CD-ROM drive can also read standard CD-DAs.

However, the Yellow Book now specifies two logical recording procedures for data:

- Mode-1
- Mode-2

The reason for this distinction is that computer data is more affected by read errors.

A read error on an audio CD will cause a sound glitch. However, a read error of even a single byte on a CD-ROM can cause a program to crash. So, data integrity is more important with CD-ROMs than with CD-DAs.

The standard error correction for CD-DA reduces the number of errors on a CD to about five or six errors. This may be satisfactory for music CDs but may be a problem for computer programs or sensitive computer data.

A recording procedure for CD-ROMs was established which reduces the error rate to one defective byte per 1,000,000 Meg, or 1,000 Gigabytes or 1 terabyte. However, this procedure also reduces the maximum storage capacity. An additional 280 bytes are reserved for error correction. A few additional bytes are "borrowed" from the data bytes, since the individual sectors must be addressed.

This leaves 2,048 bytes of usable storage for data per sector.

CD-ROM Basics

CD-ROM Mode-1 sector partition

This recording procedure is referred to as Mode-1.

Another procedure in the Yellow Book, called Mode-2, does not include the 280 additional check bytes. This increases the storage capacity but at the expense of less data integrity. In practice, however, this procedure is unimportant. Few CD-ROMs are recorded using Mode-2. In principle, it's possible to read such CD-ROMs in any drive, provided you have the special software for it.

CD-ROM Mode-2 sector partition

You can calculate the transfer speed like you did with the CD-DA. Here too, 75 sectors per second are read. However, the sectors contain fewer usable bytes. In Mode-1, 2,048 data bytes are available. This results in a data transfer rate of 75 x 2,048 byte/s = 153,600 byte/s = 150K/s for Mode-1. For Mode-2 the data transfer rate is 2,336x75 bytes/s = 175,200 byte/s = 171K/s.

Mode-1	Mode-2
Error rate 10h^{12}, i.e., one incorrectly read byte per 1 terabyte	Error rate 10^{8}, i.e., one incorrectly read byte per 100 Meg
2,048 usable bytes	2,336 usable bytes
280 extra bytes for error correction	The Kodak Photo CD lets users store conventional photo images on CDs. Meanwhile, the photo CD, which is somewhat different from the XA standard, has developed into a world-wide recognized standard.
Error correction according to Red Book and Yellow Book	Error correction according to Red Book
Data throughput: 150K/s	Data throughput: 171K/s

You can determine the storage capacity of a CD-ROM if you know how many sectors it has. Simply multiply the number of sectors times the capacity of usable bytes.

You can also calculate the maximum total capacity of a CD-ROM with this information. Often there is conflicting information and maximum capacity values. To determine this value, you need to know the maximum possible number of sectors. This may depend on different factors, e.g., on the data arrangement or the mode that is used. However, there's another crucial factor for this range which can vary from 527 to 742 Meg. Occasionally, CD-ROMs will also specify a playing time in minutes. As with audio CDs, the individual sectors of a CD-ROM can be set through minute, second and sector values. Once you know the playing time of a CD, you can draw conclusions about its capacity. If a CD's playing time is listed as 60 minutes, and you consider that 75 sectors per second are read, you can calculate the number of sectors in the following manner:

There are 60 minutes X 60 seconds X 75 sectors, or a total of 270,000 sectors. With a CD-ROM recorded in Mode-1, a sector contains 2,048 usable bytes. This gives you a total capacity of 270,000 x 2,048 bytes = 552,960,000 bytes = 527 Meg. In Mode-2, with 2,336 useful bytes per sector, it would be 270,000 x 2,336 bytes = 630,720,000 bytes = 602 Meg.

However, a specification of 60 minutes total playing time is more likely to be an outdated value. This value is a carry-over from the early days of CD production. It results from the fact that the outer edge of the CD cannot be recorded for technical reasons. Meanwhile, the technology has been refined and that area of the CD is being used to greater advantage. The rule today is 63 or 74 minutes of playing time. On 74 minute CDs, you get 74 minutes x 60 seconds x 75 sectors = 333,000 sectors. According to the calculation used earlier, the capacity in Mode-1 totals to 681,984,000 bytes = 650 Meg, while in Mode-2 it amounts to 777,888,000 bytes = 742 Meg.

Total capacity of a CD-ROM		
	63 Minutes	74 Minutes
CD ROM/Mode-1	554 Meg	650 Meg

With databases of up to 554 Meg you are dealing as a rule with a 63 minute CD, while any capacity beyond this figure indicates a 74 minute CD.

CD-ROM/XA and multisession capability

CD-ROM/XA is an incremented advancement of CD-ROM, with XA representing eXtended Architecture. CD-ROM/XA is downward compatible with the CD-ROM standard, meaning that any XA drive can read standard CD-ROMs.

The innovations in the XA standard include the following:

CD-ROM Basics

- A new, very effective means of compressing audio data
- Nested storage of data, call sector interleaving
- New sector format

This standard is also based on the Yellow Book (like the standard CD-ROM was). Microsoft joined Philips and Sony in 1989 to expand the definition of the Yellow Book. The expanded definition included concerns resulting from the use of multimedia. Some elements of the Green Book, specified for CD Interactive (CD-I), were adapted to standardize the compression of audio data. In 1991 this new version of the Yellow Book, called the Extended Yellow Book, was completed. It was also referred to as Phase 2 of the CD-ROM/XA standardization.

Phase 3, presently under consideration, is to include the compression of digital image information. This will make digital video possible in better quality and for longer duration.

However, the existing functions of the CD-ROM/XA standard already meet higher standards. In addition to the audio data defined in the Red Book, another audio format was established for CD-ROM/XA. In this new format, an XA drive together with its controller must be able to read and simultaneously decompress tightly compressed audio data. After some concessions in quality, this data requires significantly less disk space. The procedure used for this format is called ADPCM (Adaptive Delta Pulse Code Modulation) which can be run in three different levels.

The high compression ratios can be achieved by reducing the scanning frequency and bits per channel. Remember, two factors are important for the quality of digital audio:

- How often the analog input signal is measured (called the scanning frequency).
- How many different values can be assigned to these measurements.

For an audio CD, the scanning frequency is 44.1 kHz, i.e., the signal is measured 44,100 times at a constant interval. The values available for the measurements depend on the number of bits per channel, for mono it's one channel, while for stereo it's two. With the audio CD you are dealing with 16 bits, which means there are 2^{16}, or 65,536 different values available for coding.

The following table shows how audio playing time can be extended by ADPCM. Improved compression contributes to making this happen. Also, as the name adaptive difference indicates, only the difference from the preceding signal are stored instead of the absolute numeric values. Since this makes the numbers smaller, the number of bits can be reduced. Finally, the scanning frequency is also decreased. As a result, the playing time is lengthened, depending on the level of ADPCM that is used - up to 19 hours per CD.

For comparison, the following table lists the data for audio CDs compressed by PCM (Pulse Code Modulation procedure).

74 Minute CD	CD-D	Level A	Level B	Level C
Procedure	PCM	ADPCM	ADPCM	ADPCM
Scanning Frequency	44.1	37.8	37.8	18.9
Bits	16	8	4	4
Compression	None	2	4	8
Mono, Hours	-	4:48	9:36	19:12
Stereo, Hours	1:14	2:24	4:48	9:36

The slightly modified sector structure and the presence of special control bytes make it possible to identify a sector as belonging to a specific file. Therefore, a file can be stored nested with another file and then read out.

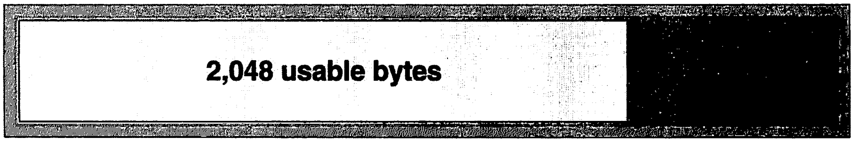
Different data can be stored within a track but in different sectors. This storage format is called the interleave format. Remember, a track corresponds to a piece of music on an audio CD and a logical drive on CD-ROM. Therefore, different data can be mixed within a track, for example, one sector of audio data followed by one sector of program. In this example, the audio data is read for 1/75 seconds and the program data is read for 1/75 seconds. This is important advantage also benefits multimedia applications. For instance, there's no need to interrupt sound reproduction while a program is loading. This continuous data flow, a kind of parallel reading of different kinds of data, is one of the great strengths of CD-ROM XA.

If an XA CD only contains normal data, it could, at least in theory, also be read by a normal CD drive provided the driver software can handle the sector format. Even nested files could be managed by software. However, if an ADPCM decoding were necessary, you would need a hardware solution. A special decoder is required to read out ADPCM data.

The sector format

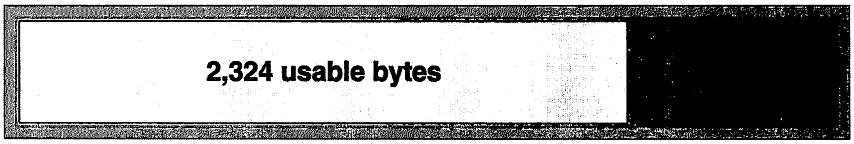
Another technical feature of the XA standard is in the arrangement of data, which has been modified slightly compared to the CD-ROM standard. There are some special control bytes which the CD-ROM standard does not recognize. Aside from that, the arrangement of the bytes corresponds for the most part to CD-ROM Mode-2, i.e., there are 2,353 bytes in a sector. Also, CD-ROM/XA distinguishes between error sensitive and less sensitive data. There are Form 1 sectors and Form 2 sectors. With the XA standard, you have Mode-2 Form 1 type sectors and Mode-2 Form 2 type sectors.

Form 1 is for error sensitive data.



CD-ROM Mode-2 Form 1 Sector Partition

Form 2 is for less error sensitive data, such as audio, video, graphic or text data.



CD-ROM Mode-2 Form 2 Sector Partition

The slightly modified sector structure and the presence of special control bytes make it possible to identify a sector as belonging to a specific file. Therefore, a file can be stored nested with another file and then read out.

Photo-CD and multiple sessions

Kodak's Photo-CD technology is based on the XA sector format. Until early 1994, Photo-CDs supported the sector format of the XA standard but not the nested files or ADPCM coding. However, Kodak has announced that Photo-CDs will also support these features in the near future.

Since Kodak Photo-CDs use the XA sector format, it's not possible to read Photo-CDs with a conventional CD-ROM drive. However, even users of simple XA drives may encounter the following problem trying to read a Photo-CD:

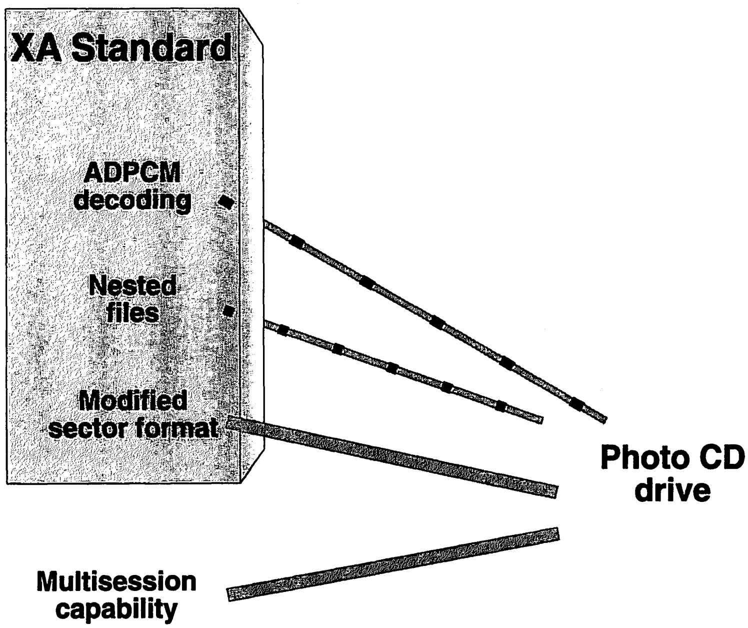
A film with, say, 24 pictures that you take to your photo dealer doesn't fill up an entire CD. A Photo-CD can store up to 100 pictures. Each time images are added to a Photo-CD, the appropriate tracks are framed with a LEAD-IN and a LEAD-OUT structure. This happens even when you store less than 24 pictures on the CD. While it's possible to store additional photos after the first 24, normal drives will have trouble reading these new images. They won't search for data after a LEAD-OUT structure.

Here's the problem: Each time you add images to a Photo-CD it's called a *session*. There are single session drives and multiple session drives. While single session drives can only read the first session, multiple session drives are capable of reading several sessions. Obviously, multiple session capability is part of the definition for complete Photo-CD compatibility. The only way to achieve multiple session compatibility is through a hardware solution.

It's the combination of the XA sector format and the capability for multiple sessions that makes a Photo-CD compatible drive.

The following figure illustrates the connection:

Photo-CD Drive



On the one hand, this means that an XA drive doesn't have to be 100% Photo-CD compatible. If the drive is not multiple session capable, you will only be able to read images created from the first session.

To be able to use Photo-CD applications, you should also include ADPCM coding and sector interleave capability from the XA standard as part of your criteria for Photo-CD compatibility.

With the appropriate driver, you can also read Photo-CDs on normal drives, however, you'll only be able to read the first session.

CD Interactive

The CD-I, with the 3DO and CD32 systems, falls outside the normal CD-ROM spectrum. You cannot play CD-ROMs in CD-I players, nor can you play CD-Is in normal CD-ROM drives. While the individual sectors of the CD-I follow the CD-ROM/XA standard, PCs cannot work with the data of a CD-I, which are designed for the home electronics market. Some information software and presentations are already available, while others are in the planning stages. You can connect a CD-I player directly to your television set or PC.

The success of CD-I and similar systems depends on the availability of key applications, or applications that are only possible with CD-I. In fact, a video application is now available. Video CDs, whose video information is compressed with the MPEG Standard, make up to 74 minutes of full-motion-video possible. This could be seen as a key application for CD-I. Until now, television quality video or near television quality video has not been possible with CD-ROMs.

For more information about video compression procedures, refer to Chapter 3.

Other examples of systems which are incompatible with CD-ROMs include 3DO and CD32 which are intended for the computer game market. Both systems are CD players that can be connected directly to your television set.

Recordable systems

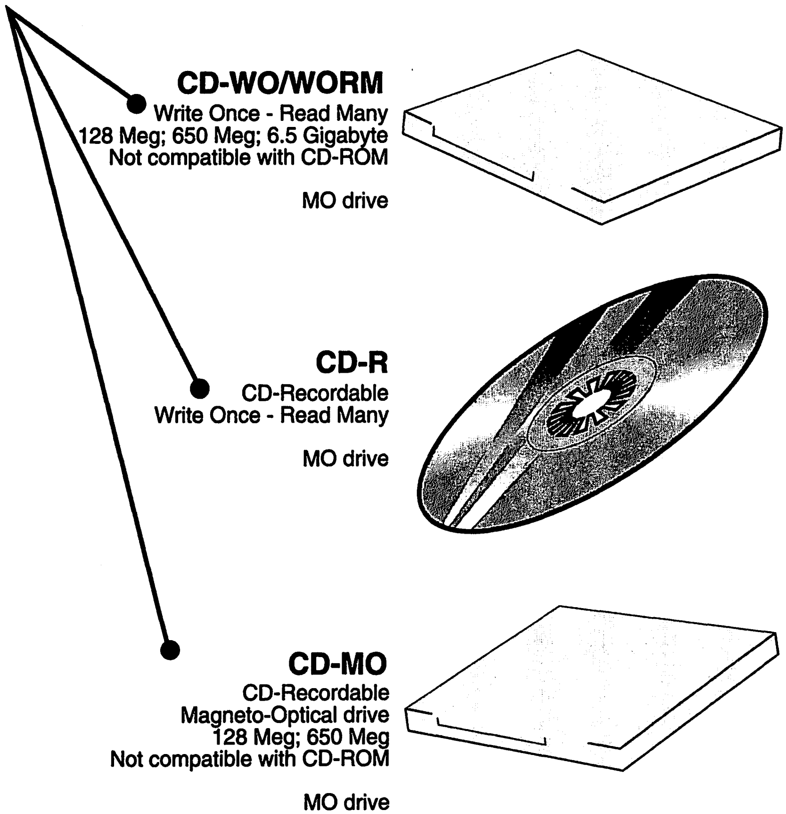
With recordable CD systems, the goal is to combine the advantages of an optical storage system with the benefits of a magnetic system. Such a system is supposed to run free of wear and tear and provide a great deal of disk space, like optical drives. Also, like magnetic storage media, the system should offer users the option of erasing and overwriting data.

These systems were originally designed in such a way that you could use it to write information. However, from the very beginning developers struggled with difficulties. A laser beam that makes changes to the optical layer must be a great deal higher in energy than a laser beam that only reads. It's much more difficult to control such a powerful laser beam. The energy level needs to be exacting so the laser beam is strong enough to change the optical layer, but doesn't penetrate the medium itself. Under these circumstances it's very difficult to keep the diameter of the laser beam small enough to still fit in the track width of a normal CD: 0.6 micrometers. Otherwise, the resulting pits would be much too large and inexact.

Additionally, the changes caused by such a laser beam would be irreversible. The 'pits' that were burned into the layer could no longer be converted to "lands". Erasing or overwriting the data would be impossible. To make a long story short, developers used different techniques.

Different systems developed, which are not compatible with one another. However, because of the exchangeability of their storage media and their great storage capacities, these systems have become very important. The first generation of these systems is represented by the CD-WO, a write-once CD which is housed in a special cartridge. The CD-R and the CD-MO replaced the CD-WO. The CD-R, or CD-Recordable can also be written to only once, but after inscription can be used like a normal CD-ROM. CD-MOs are magneto-optic discs, a combined technology. CD-MOs can be recorded more than once, are enclosed in a cartridge and, naturally, can only be used with special MO drives.

Recordable systems



In 1991, Philips and Sony specified the Orange Book to create compatibility at least within the various platforms. The first section defined the CD-MO (Magneto Optical), while the second part defined the CD-WO (Write Once).

CD-WO

The starting point for recordable storage media was the CD-WO or CD-WORM (Write Once Read Many). Because the disc is in a special cartridge, it neither resembles CDs nor is it compatible with normal CD drives.

There are two models for CD-WO drives and storage media:

1. Data can be written in a spiral shaped track, like CD-ROMs.

2. Data is written in concentric tracks like hard drives.

When data is recorded in a track in a spiral shape, it's called Sampled Servo (SS). A second and more popular procedure is called the Continuous Composite Servo (CCS); it has data that is arranged in several concentric tracks. The two procedures are not compatible with each other.

CD-WOs come in three sizes:

- 3.5-inch with 128 Meg
- 5.25-inch with 650 Meg
- 12-inch with an incredible 6.5 Gigabytes

However, the recording technique doesn't use a laser that burns small pits into the surface. Instead, the unrecorded CD-WO has a recording layer with organic paint. Its reflective properties are changed when the recording laser illuminates this paint. The laser beam that reads the information is polarized differently in the appropriate places.

Newer techniques are making the CD-WOs less popular to use today, although they're still being used occasionally for archiving purposes.

Be careful with confusing terminology: Sometimes a system is referred to as CD-WO when it's actually a CD-R system.

CD-R

Basically, the recording technique of a CD-R (Recordable) is the same as a CD-WO. The CD-R is identical in appearance to a CD-ROM except for its gold colored surface. It doesn't need to be enclosed in a cartridge and once burned can be used like a normal CD. When recording the CD, you can specify whether its sector format should be a standard CD-ROM, the XA or Photo-CD standard, or just the CD-DA standard.

The idea of marketing a CD that, once written, can be used like a conventional CD-ROM, may turn out to have a very promising future. This is especially true when you consider the prices for CD-R drives, known as CD-ROM writers, continue to fall.

The PC system used to control a CD Writer must be a powerful system. Since the CD Writer requires a constant data transfer rate during the write operation, the entire data contents needs to be instantly accessible. The hardware must be capable of transferring data continuously at 800K/second.

CD-MO

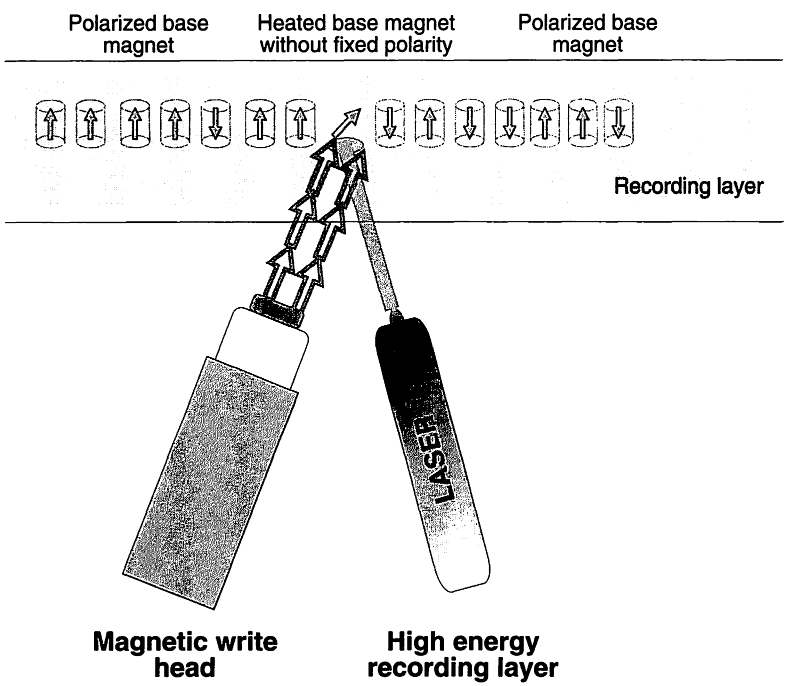
A CD-MO (Magneto Optical) drive combines both magnetic and optical technologies. This technology provides a storage medium that can be recorded multiple times.

Data is stored magnetically, like it is on hard drives. The arrangement of the information on the platter is well protected from accidents or other effects. Only high amounts of energy can change the information. A thermo-magnetic procedure is used for recording. A laser beam heats a specific area on the magnetizable layer to the Curie point (over 200 degrees Celsius) for a fraction of a second. Only during this time can the polarity of the magnetized materials on the layer be changed by the write head, which works like a conventional magnetic read/write head. Shortly after the particles have been heated up, they cool down again and retain their polarity.

Then, a special laser can read the data. Although this laser is too weak to change the polarization, the areas that are polarized at varying degrees deflect (or refract) the laser differently.

Scanning with the laser

CD-MO Recording Methods



This medium is called CD-MO or CD-MOD (Magneto Optical Disc). It comes in the following capacities:

- 3.5-inch drives with 128 Meg
- 5.25-inch drives with 650 Meg.

The techniques used in this recording procedure prevent the tracks from being written as narrowly as you can with a normal CD. The sector size of 512 bytes is much less than the sector size of a normal CD, which is 2,048 bytes. Since a normal laser is not deflected by the magnetized particles in the same way as the MO scanning laser, MOs are incompatible with conventional CDs.

Floptical

Floptical technology also combines magnetic and optical recording. The special feature of floptical drives is that they can also read normal 3.5-inch diskettes with capacities of 720K and 1.44 Meg. That means you can install a floptical drive in your computer in place of a 3.5-inch disk drive. When you consider the fact that floptical discs have a storage capacity of 21 Meg, replacing your old 3.5-inch drive with a floptical may be a good idea.

The remarkable feature of this drive is the magnetic read/write head is aligned precisely by a laser. The laser uses grooves located on the surface to guide the positioning mechanisms. The optical component of the drive technology is only used to align the read/write head. Other than that, the floptical is a normal magnetic medium.

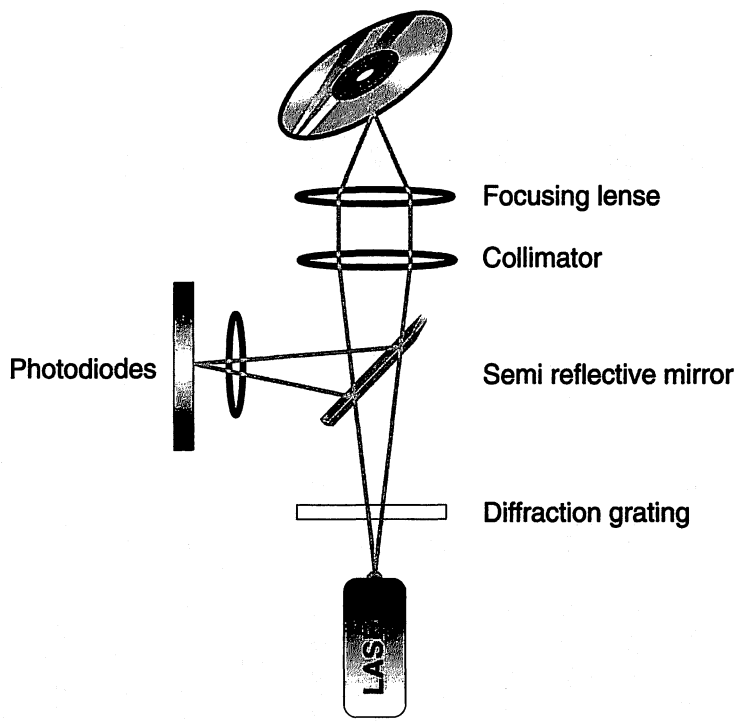
How Your CD Works

The overwhelming success of CD systems can be attributed to the following two properties of laser technology:

- Reading of the CD-ROM surface using laser uses optical techniques; therefore there is no contact or wear and tear on the CD surface.
- The laser beam can be focused so precisely that its diameter can be decreased to such an extent that information can be stored on tracks that are very close to one another. The result is very high recording density.

The basic principle behind CDs is quite simple and is seen in the next illustration.

How optical scanning works on a CD-ROM drive



Laser beams are directed onto the CD-ROM. On their way, they penetrate the semi-reflective mirror. Before the laser beams hit the CD, they are aligned by a series of lenses. A collimator paralyzes the laser beam. The beam shrinks to an astounding 0.6 micrometers in diameter, by this time it reaches the surface. The beams pick up the information on the surface of the CD and are then reflected. The semi-reflective mirror redirects the beams to the photodiodes. From there, the electronic processing takes place.

What is a CD-ROM?

A CD is a transparent layer of polycarbonate (plastic) 4.75 inches in diameter and 1.2 millimeters thick. It has a reflective layer of aluminum and a protective coating of paint. This coating of paint protects the CD from small scratches and dust.

A circular hole 15 millimeters in diameter appears in the middle of the disc.

You may be surprised that a CD-ROM drives always read the data from the bottom of the disc and not from the top where you see the label.

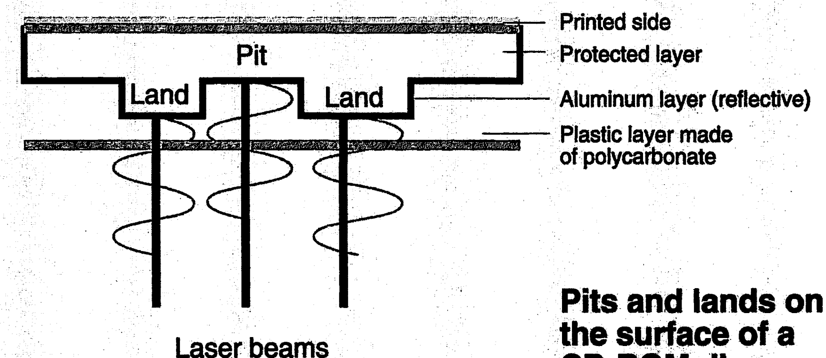
CD-ROM Basics

If you examined the surface of the CD carefully with a microscope, you would see that it has several small indentations called *pits*. The areas between the pits are called *lands*. These tiny pits and lands represent the information on the CD.

Approximately 4-5 million pits per CD are arranged in a single, outward running spiral. This spiral is referred to as a track and is 3.75 miles (6 kilometers) long. The elements of the track are so dense there is only 1.6 thousandths of a millimeter between each element. If you imagined that the CD had been enlarged to 12 meters in diameter, there would still be more than six tracks next to each other within one millimeter.

One striking difference when you compare a CD with a high density 3.5-inch diskette is the tpi, or tracks per inch. The high density 3.5-inch diskette manages to store 96 tracks per inch, while the CD has 16,000 tracks in the same space!

Surface of a CD-ROM disc

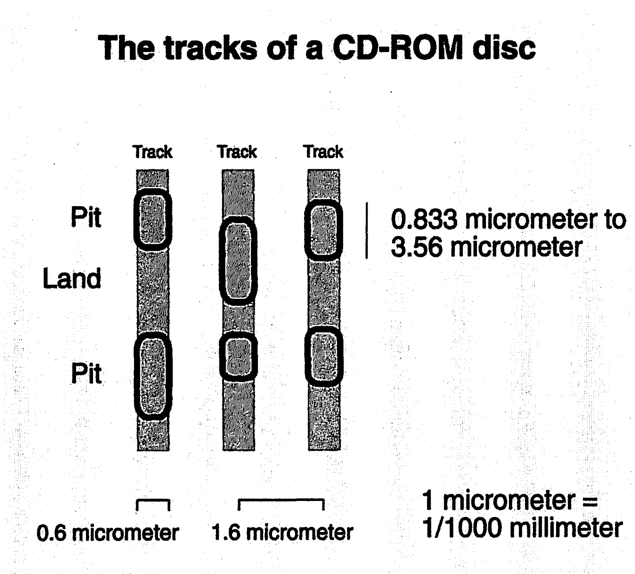


Pits and lands on the surface of a CD-ROM disc

The incoming laser light is reflected both by the pits and the lands. Since the pits are deeper than the lands, there is a slight time difference of the reflected light from the laser. The depth of the pits is designed to be precisely half a wavelength deep.

As a result, the adjacent reflected laser beams in the transitions between the pits and the lands erase each other. The light of the laser that hits the pits and lands is reflected in its entirety, while almost nothing is reflected from the laser beams in the transitions between them. This makes it easy for the photodiode circuitry to decode the data.

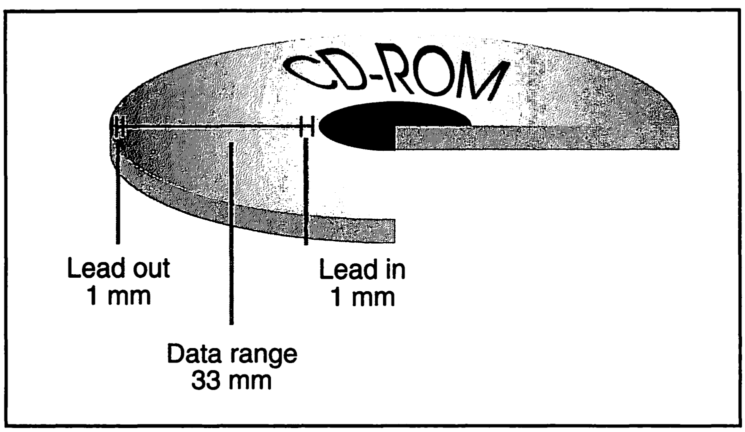
The tracks of a CD



Arrangement of information on the CD

Neither the pits nor the lands represent information on the CD. Instead, it's the transitions in between pits and lands that carry the information.

Cross section of a CD-ROM disc



The smallest unit of information on a CD is called a *channel bit.* The logical value of 1 is represented by a transition between land and pit. Those are precisely the places on which nothing is being reflected. A land or a pit represents a 0. A byte is made up of 14 (not 8) of these channel bits.

You'll find a more thorough description of data coding on the CD and error detection in Chapter 4.

Every CD-ROM contains at least three data areas. The first area, on the innermost tracks of the disc, is called the LEAD-IN. It contains the table of contents, sometimes called the CD TOC. After the LEAD-IN comes the actual data, and at the end of the CD comes the LEAD-OUT. These three areas, the LEAD-IN, the data and the LEAD-OUT are also referred to as a session. If a CD has more than one session, it is called a multiple session CD.

The smallest logical data block that can be read from the CD is a sector. That is, a complete sector must always be transferred. Sectors aren't exclusive to CD-ROMs; you'll also find them on other storage media, such as hard drives. The sector size varies on hard drives, it depends on the total capacity of the drive. For example, a hard drive with one gigabyte storage capacity has a sector size of 16K. On a CD-ROM, a sector always contains 3,234 bytes. This figure includes 784 bytes for error detection and correction.

With varying rotation speed

Each sector of a CD has the same length. It's this feature that makes them different from the sectors of a hard drive. No matter where the track is located on the disc, the sectors will always be of equal length. There are more sectors within a revolution at the end of the track, or the outside of the CD, than on the inside, closer to the center.

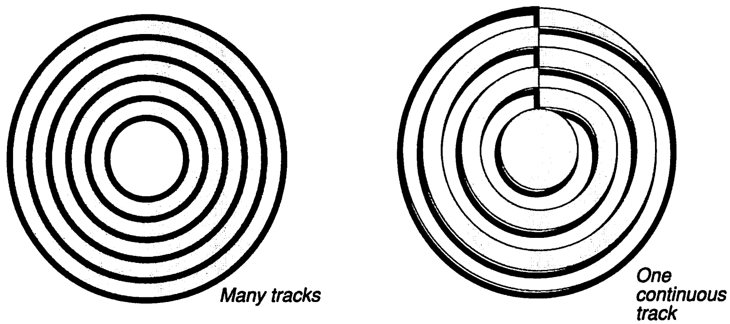
To scan the surface, the laser has to maintain the same speed over each sector. It has exactly 1/75 of a second to pass over a sector. That means the rotation speed must vary. When outer areas are being read, the rotation speed is very high, when the drive accesses the inner areas, the speed decreases.

The speed of the read head above the CD surface is always 1.3 meters per second. When the head is over the outer edge of the disc, the CD turns at 500 revolutions per second, while the head turns at 200 revolutions per second when it is over the inside of the disc.

When information is stored in sectors of equal length within a track, as is the case with a CD, we refer to it as CLV mode (Constant Linear Velocity). Hard drives don't store information this way. Hard drives have many tracks arranged in a concentric circle around the center. Each track contains the same number of sectors. This procedure is called CAV mode (Constant Angular Velocity).

Methods of storage

CAV and CLV storing methods



Hard drive / Diskette

CAV principle
Constant Angular Velocity
Hard drive spins at
constant speed

CD-ROM

CLV principle
Constant Linear Velocity
Constant read speed varying
rotational speed of CD

The Drive Speed

Often you'll be able to find technical information about a CD-ROM drive on the specifications ("spec") sheet. Two values you should notice are related to the speed of the drives: The data transfer rate and the mean access time.

The data transfer rate is the speed at which the drive can transfer data to the computer. Earlier, we found this value to be 150 kilobytes per second (1K/s). For a long time, a data transfer rate of 150K/s was the standard. Slight deviations are tolerable. This deviation may be the result of the hardware configuration or the buffer memory integrated in the drive circuitry. However, buffer storage only means a gain in speed when you're trying to reread the last data read which happens to reside in the buffer.

The data transfer rate remained the same until doublespeed drives were introduced. As its name suggests, the rotation speed on doublespeed drives has been doubled. When you access the data with a doublespeed drive, it rotates at twice the speed. The drive can be switched back to normal speed to read audio data. Doublespeed for computer data means that twice as many sectors can be read per time unit. As a result, the data transfer rate increases to 300K/s. Recent advancements now include drives with quadruple rotation speed (quad-speed drives). The data transfer rate of 600K/s that can be achieved with a quad-speed drive approaches the speed of some hard drives.

Hard drives of the top performance class attain a data transfer rate between 800K/s and 1.8 Meg/s, thus are faster by as much as a factor of 10.

However, before data can be transferred, the desired sector must be selected. If the desired sector is on the outer edge of the CD, but the laser is positioned on the inside, access will take longer than if the laser is switching between two adjacent sectors. So, different values are used to specify the access time. One common specification is called mean access time.

Mean access time is the amount of time required for the head to move over half the tracks. Specifications for mean access time vary between drives, with values ranging from 200 to 400 ms. Hard drives have a clear advantage here. While CD-ROM drives are gradually catching up in data transfer rates, only slight progress is to be expected in access time. Mean access times less than 10 ms are not uncommon for hard drives; under the most favorable circumstances, CD-ROM drives will have access times 20 times higher. In addition to mean access time, frequently a value for maximum access time is also specified. Maximum access time is the time for the head to move from the innermost to the outermost track.

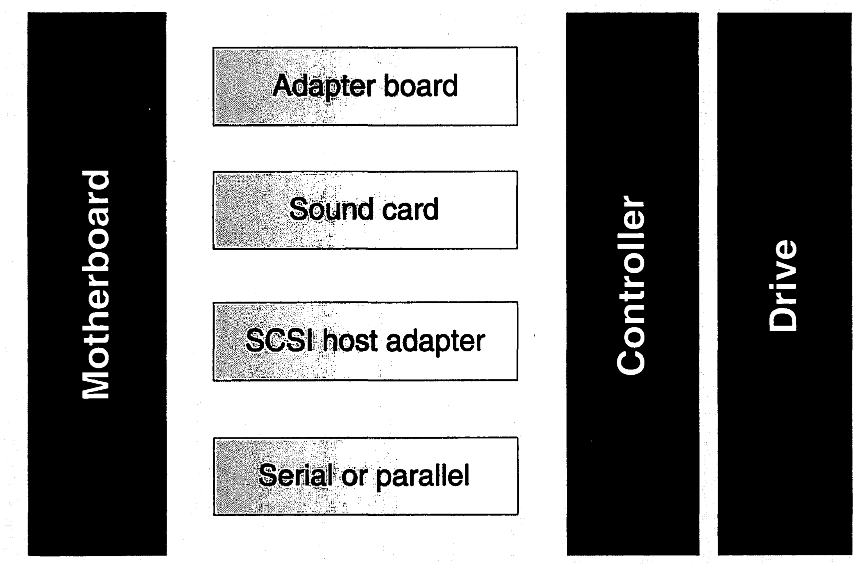
The companion CD contains the CDCHECK program. By using this program you can check the values for data transfer rate and mean access time. In addition to the mean access time, the program measures an access time resulting from going to randomly selected sectors. You can also display the maximum access time with CDCHECK.

It's on the companion CD-ROM

You'll find the CDCHECK program in the \CDCHECK directory.

The Ports

Like a floppy or hard drive, a CD-ROM drive is a peripheral device that must be connected to the bus of the PC through a controller. The illustration on the following page shows you the types of controllers. The controller may be a separate proprietary adapter board, it may be integrated on a sound card or it may be a SCSI host adapter. Some CD-ROM drives can be connected directly to the parallel or serial port. The controller is built into the drive for these types of CD-ROM drives.



Ways to connect a CD-ROM drive

Adapter boards

Some CD-ROM controllers are located on an adapter card that is plugged into one of the PC's expansion slots. These adapter cards are specifically designed for a particular CD-ROM drive and are sold with the CD-ROM drive. In most cases, proprietary adapter boards are not interchangeable.

Sound cards with an integrated CD-ROM interface

Some sound cards have built-in CD-ROM controllers. Certain models of the Sound Blaster or Audio Blaster Pro are examples. Panasonic, a large CD-ROM drive manufacturer, has tried to standardize the sound board CD-ROM connection called MICE. Other CD-ROM drive manufacturers use a proprietary Mitsumi interface.

Some of the newer sound cards have a SCSI interface (Small Computers System Interface). The SCSI interface lets you connect several peripheral devices simultaneously. This standard originated with Macintosh computers and was later adopted in the PC world, where it has become the most efficient option for connecting drives.

The SCSI host adapter

The SCSI card, which you can install in your PC, is called a host adapter. In fact, a host adapter really is a kind of host for many types of peripheral devices. There are two different SCSI host adapters:

1. A small 8-bit SCSI host adapter lets you connect a maximum of two SCSI devices. The devices could be CD-ROM drives, hard drives, tape drives, flopticals etc.

2. A larger 16-bit SCSI host adapters can manage up to seven additional devices.

The SCSI interface operates at a higher processing speed than other interfaces. That's why most doublespeed or quadspeed drives are manufactured with the SCSI interface. Another advantage of SCSI is its flexibility with future operating systems. This interface is required for the Windows NT, OS/2, and UNIX operating systems, since other CD-ROM connections are not supported.

Connection options

Serial ports for CD-ROM drives are quite rare. We only know of a few drives that work with the RS-422 interface. Two of these drives include the Philips CM 205 and CDD 462, both of which have been around for a while. Since we're dealing with a type of Philips standard here, the selection of controllers is very small. Only the Philips 8 bit controller and a version of the Pro Audio Spectrum designed specially for Philips have RS-422 adapters.

Parallel ports are more common, and are preferred for use with notebooks, which usually don't have internal connection options for a controller. While connecting external devices does not pose a problem, the data transfer rates are quite low.

You can also purchase a SCSI adapter which can be connected to the parallel port. In this case, any SCSI CD-ROM drive can be attached to the notebook.

Different CD-ROM Configurations

Let's look at a few of the features that differentiate CD-ROM drives.

Internal or external drive ?

Two factors determine if you'll use an external drive. The first is whether you'll use the drive with more than one computer. The second is if there's enough room for the CD-ROM drive and controller in your PC.

One special type of external drive is the portable. These have durable cases and most can be powered by batteries. They are more expensive than standard external drives, however.

We recommend purchasing an external or portable drive only if there's no other solution for your computer. You'll have to determine if their higher cost and poorer performance will satisfy your requirements.

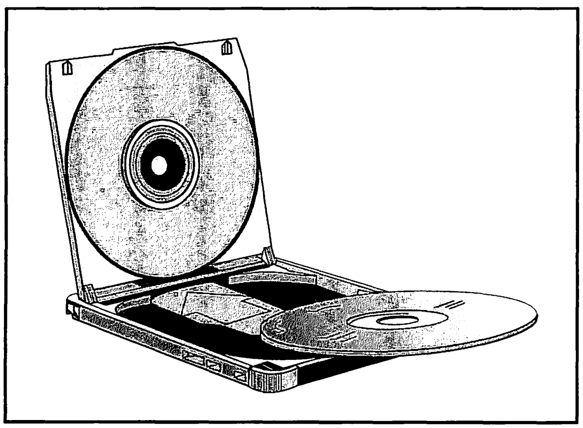
Should I get an upgrade kit ?

Often CD-ROM drives are bundled with sound cards as an upgrade or multimedia kit. To determine whether you should consider such multimedia packages, consider the example of stereo equipment. When you want to buy stereo equipment, you're faced with the same choice of buying a complete stereo system or buying different components such as the amplifier, tuner, CD player, tape deck, etc. If you choose the first option, you won't need to assemble the components and you've got a system that is guaranteed to work immediately. However, the best way to maximize technical performance and personal preference is to build your own system out of individual components.

You can transfer these experiences to the combination of CD-ROM drive, controller and sound card. We recommend purchasing a multimedia kit if you're looking for a reasonably priced solution and want to have the least amount of trouble getting the kit up and running. If you want maximum performance, build your own system with individual components: 16 bit sound card, SCSI controller and a doublespeed or quad speed drive.

The load and drive mechanism

Users often underestimate the importance of the CD-ROM drive mechanism. In some drives the CD-ROM is inserted in a special plastic cartridge, called a *caddy*, before you can insert the CD into the drive.

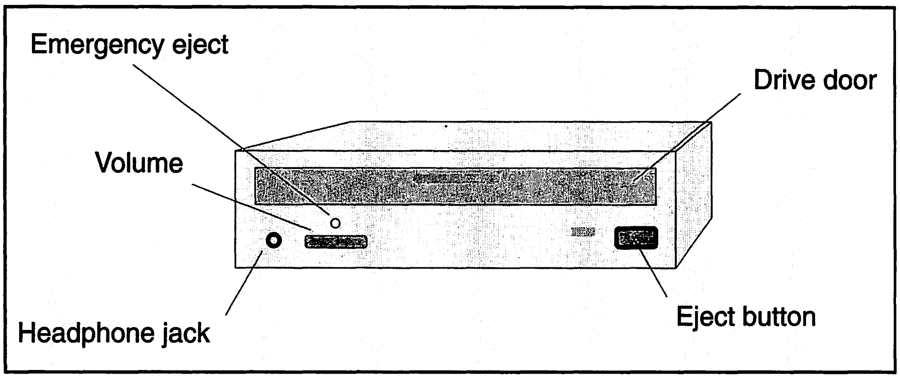


A typical CD caddy

This extra case for the CD is a very practical idea. But despite their sturdiness, a CD-ROM can be damaged with frequent or careless use. Read errors on the CD can lead to catastrophic consequences. A caddy helps protect and extend the life of the CD-ROM. Since the number of CD-ROMs being used is dramatically increasing, we recommend storing your most valuable CD-ROMS in a separate caddy. Examples of the most valuable CD-ROMs would include the most expensive and those which are used frequently.

Some CD-ROM drives have a motorized drive tray like those on an audio CD player. While it's more convenient to work with such drives, the CD-ROMs are much less protected as they are in a caddy.

One small, but convenient part of a CD-ROM drive is the eject button. Higher end models usually have motorized ejection. While this option is quite convenient and enables users to eject CDs through software, there is one disadvantage. You cannot press the eject button when there is no power for the drive. For such cases, the drive should also have an emergency eject mechanism or button. Usually there is a small opening into which you can insert a paper clip to remove the CD-ROM.



Front view of a standard drive

Another point to consider is whether your drive bay is covered by a door. The optical mechanism and drive motor components are extremely sensitive to dust. A door will protect those parts from dust. It should close whenever you insert or remove the caddy. High quality drives also have an automatic cleaning mechanism. These drives have a built in brush which removes dust and foreign particles from the mechanism at regular intervals.

Audio capability

As we've noted, virtually all CD-ROM drives are capable of playing audio. This is because the manufacturers have managed to house the necessary electronic circuitry for converting digital audio data back to sounds on a single chip. Most drives have a headphone jack and some have one or even two audio jacks to connect to a stereo system.

CD-ROM Basics

Reading a conventional CD-ROM that meets the Yellow Book standards, like playing back an audio CD, is a task that your drive should be able to perform. The only requirement is the drive support the ISO 9660 and High Sierra standards for the file system of the CD-ROM. Only very old drives (built prior to 1989) may be equipped for the High Sierra standard, but not for ISO 9660. Make certain the drive you select has audio capability.

Three CD-ROM configurations

Configuration 1: Standard CD-ROM drive

For the difference in price between a standard CD-ROM drive and a multiple speed CD-ROM drive, we recommend you spend the additional money for the added performance. Purchase a standard CD-ROM drive only if cost is the most crucial factor. In fact, it's hard to find a store that sells standard single speed drives today.

Single speed drives acceptable for users who want to do the following:

- Access collections of data, whether it's shareware, fonts, clipart or multimedia data: The important consideration is that you'll only be accessing the CD-ROM drive occasionally.
- Install your programs to the hard drive and prefer using the CD-ROM for installation over a large number of installation diskettes.

Technical Data:

The data transfer rate is approximately 150K/s. However, models of the current generation of products already support the XA standard and multisessions. The controller is contained on a special adapter card or a sound card. You can also find drives of this category in upgrade kits.

Configuration 2: Multi speed drives

This term refers to all drives whose data transfer rate exceeds the standard 150K/s.

If you plan to use the CD-ROM drive for more than the occasional copying of files, we recommend this configuration. You'll really notice the difference with a data transfer rate of 300K/s or more, especially with multimedia applications.

Depending on your hardware, the uses of this configuration range from hobby up to professional:

- Multimedia libraries and programs
- Starting programs from CD-ROM
- Kodak Photo-CD
- Tutorial and information software

The technical data can vary dramatically: Data transfer rates starting at 300K/s, for professional use 600K/s. In most cases, a SCSI controller serves as controller.

If you're not using a SCSI controller, you may want to consider using an XA controller. A complete XA system consists not only of an XA capable CD-ROM drive, but also an XA controller. This controller contains the necessary decoder for ADPCM audio data. Currently the number of CD-ROMs that use this technology is quite small, and users can do without the expensive special XA controller. A standard controller is sufficient for now. In the future, when prices for XA controllers begin to fall and the number of applications increases, you can switch to the XA model.

Some older CD-ROM drives can be upgraded. For example, Philips offers an upgrade for their extremely popular CM-205, making the drive both XA compatible and multisession compatible.

Also, if you plan to use the drive mainly for editing Photo-CDs, make sure the drive conforms with the complete CD-ROM/XA standard.

Configuration 3

Configuration 3 is intended for users who require recordable storage media. There are two different groups of system requirements:

Group 1

CDs that can be recorded once and cannot be changed afterwards are desirable for the following:

- Archiving Data
- Creating CBTs and Information Systems
- Creating Custom Sound Storage Media
- Master Discs

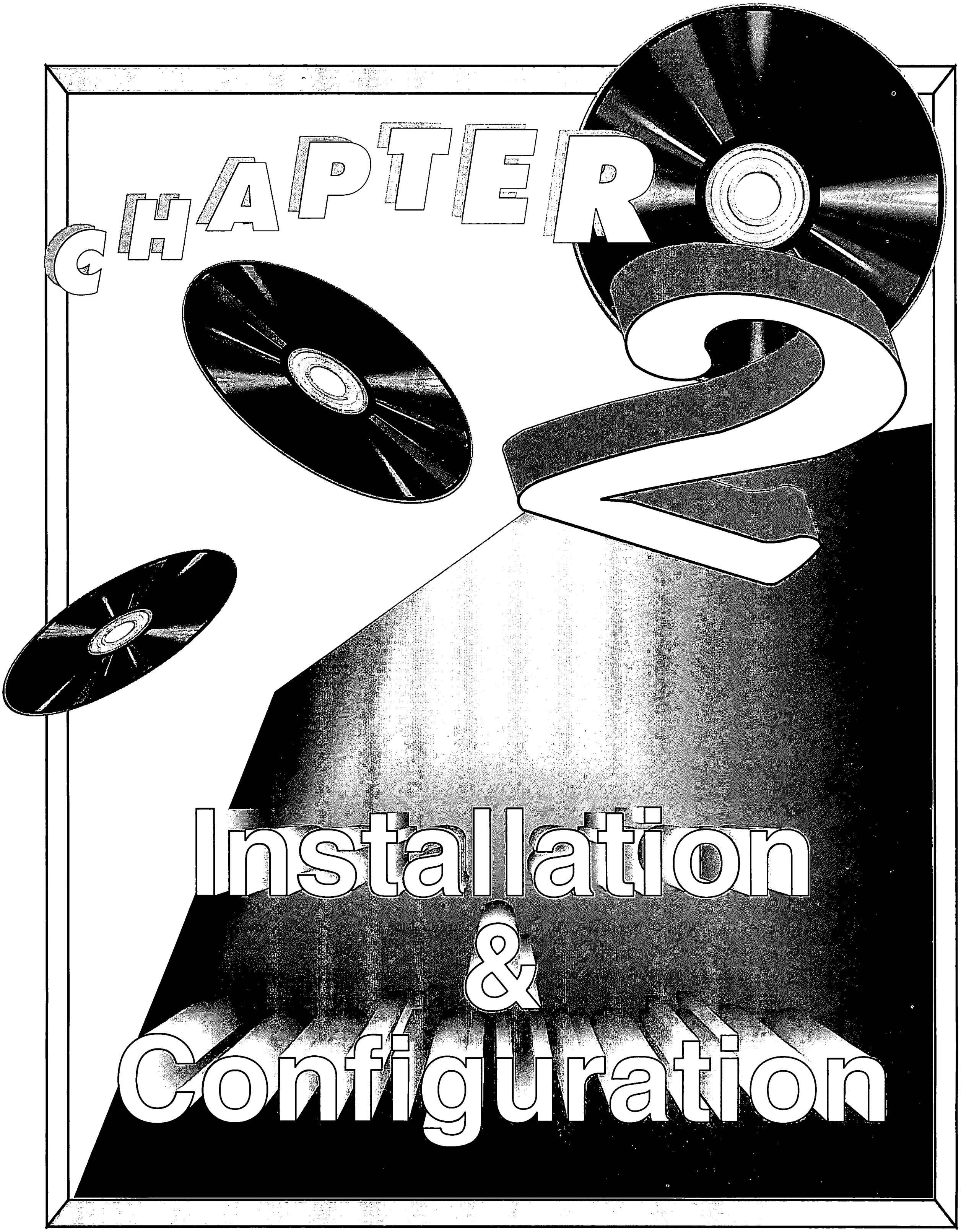
The CD-R is suitable for these purposes. After recording, you can read this type of CD in any CD-ROM drive like any other CD-ROM.

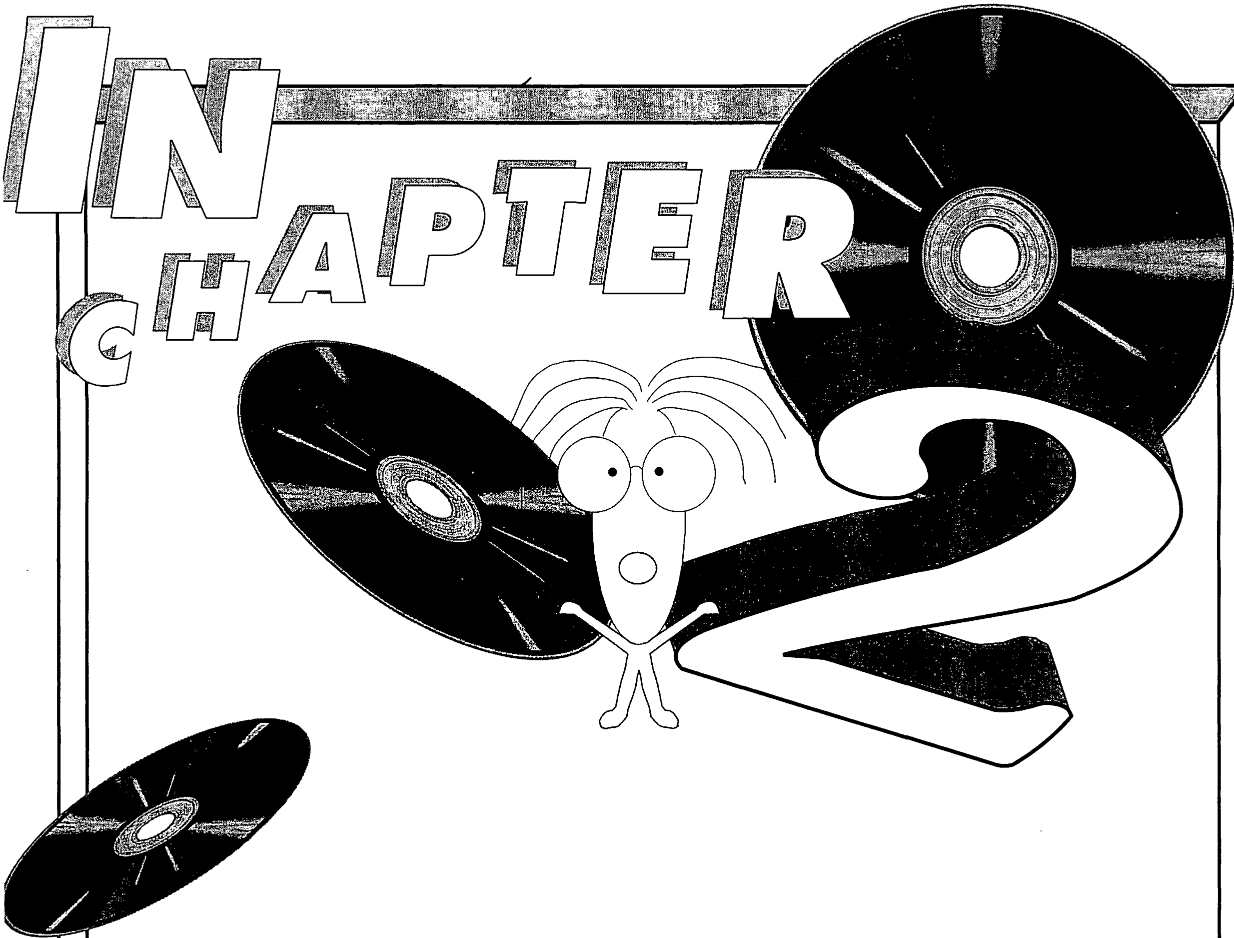
Group 2

Media that can be recorded more than once are practical for the following:

- Storing text, images, sound and video
- Templates for forms, layouts etc.
- Backups
- Presentations

MO drives are best suited for these purposes.


CHAPTER
2
Installation
&
Configuration


IN CHAPTER
2

2 Installation & Configuration 2

In this chapter, we'll describe the procedures you should follow if you're ready to install your CD-ROM drive. First, we'll introduce the different hardware configurations and potential challenges in hardware installation:

- Port configurations with interrupts
- I/O base addresses and DMA channels
- SCSI addressing and termination

The following sections discuss the step-by-step instructions you'll need to install your CD-ROM drive successfully. This chapter also describes software configuration and fine-tuning your CD-ROM.

Before Installing Your CD-ROM Drive

Installing and configuring a CD-ROM drive properly can be a challenge. If you purchased your CD-ROM drive from a mail order company or discount/warehouse store, you've probably already discovered that most do not or cannot offer any technical help after they sell you the drive. However, installing a CD-ROM drive can be easy if you follow the directions carefully and learn to "troubleshoot" any problems you may encounter. By following the steps in this chapter, you should be able to install your CD-ROM drive, and configure the software, in less than an hour.

We've found the different configurations have one thing in common: You can divide installation into four basic stages (see the following diagram).

Chapter 2

Installation & Configuration

Installation

⇩

Cable connections

⇩

Hardware configuration

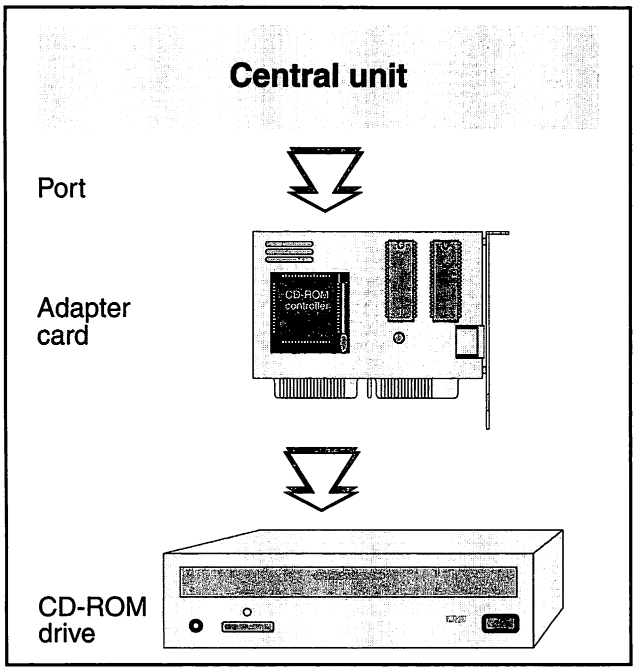
⇩

Software configuration

Basic stages of installation

Besides the CD-ROM drive, you'll probably find other hardware components included with your CD-ROM kit. These components may include cables, diskettes, an adapter card or even a sound card.

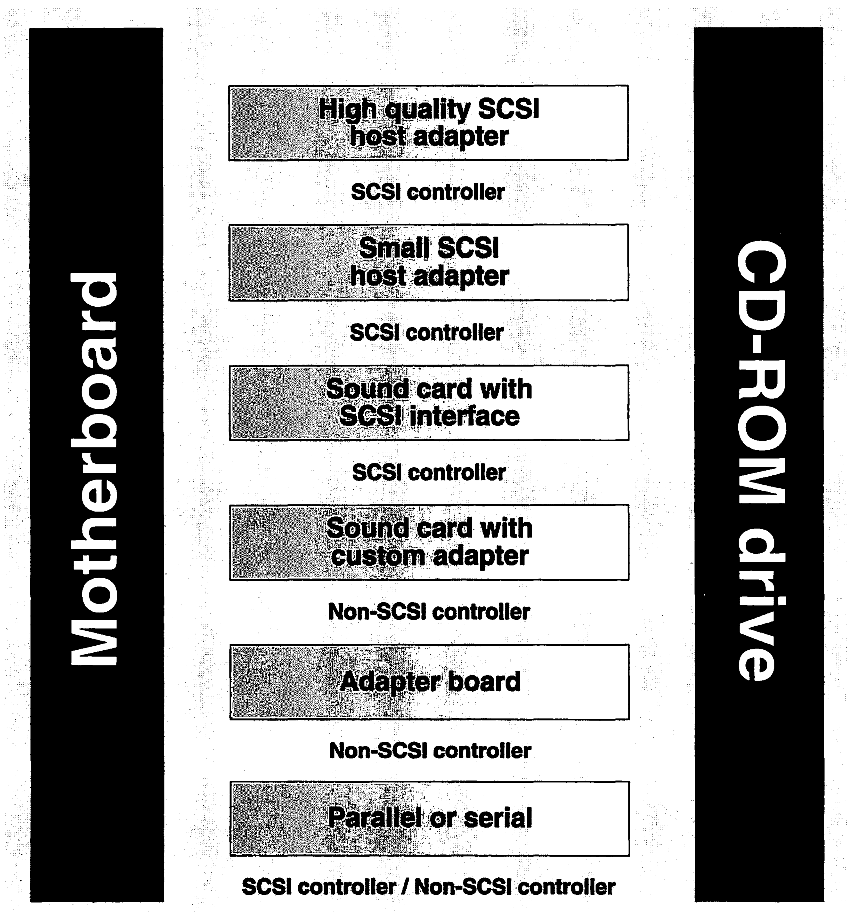
All peripheral devices, including hard drives and CD-ROM drives, must be connected to a controller. In most cases, the controller is on a separate adapter card or on a multifunction card such as a sound card.



Port and controller

The controller, to a certain extent, provides the connection between the central processing unit (CPU) and a peripheral such as the CD-ROM drives. To use the peripheral, a program communicates with the controller, not the actual peripheral itself. The controller in turn does the work of communicating with the peripheral (see the previous illustration).

Whether you purchase a CD-ROM drive and controller together or you purchase a separate drive to be connected to a controller already installed in your computer, the following shows the different types of controllers. Since each controller is connected to the central unit by a port, this list is similar to the overview of ports or controllers from Chapter 1.



CD-ROM ports and controllers

Installation & Configuration

SCSI host adapter

In this case, the controller is already installed in your system. Your hard drive is already connected to the controller. You can connect up to seven devices to a SCSI host adapter. These devices include tape drives, floptical drives, etc., in addition to hard drives or CD-ROM drives.

Since our SCSI CD-ROM drive connects directly to the SCSI host adaptor, you do not need to use an additional slot on your motherboard.

The most popular SCSI controllers are the Adaptec 1542B or Adaptec 1542C. Other popular SCSI host adapters are manufactured by Trantor and Future Domain.

You can also connect external SCSI CD-ROM drives to a SCSI host adapter. SCSI host adapters usually have an external SCSI port.

Small SCSI host adapters

Using a small SCSI host adapter, you can connect up to two drives to your computer. Since small SCSI host adapters are add-on cards, they require an extra slot. However, these cards are quite inexpensive (often under $50). The advantage of using a small SCSI host adapter is that it can be easily integrated into an ISA computer system.

While you can buy these adapters to install a CD-ROM drive, they're usually bundled in a CD-ROM drive kit. However, if you're already using such a card with two devices connected to it, for example a tape streamer and a cartridge drive, you won't be able to connect a CD-ROM to it since there aren't any unused parts. One exception to this would be externally connected devices, which you could then interchange for other devices.

Sound card with SCSI interface

New sound cards, such as the Creative Labs Sound Blaster 16, include an integrated SCSI-2 interface. Other SCSI cards offer expansion options in the form of small cards or chips that can be placed on the card.

Sound card with an individual adapter

This is an older type of sound cards for CD-ROM connection. To convert a normal PC to an MPC (multimedia PC), it was necessary to add a sound card and a CD-ROM drive to it. Using this approach, both components are combined.

If you purchase a CD-ROM drive separately to connect to an existing sound card, make certain that it is compatible with the sound card. In general, three types of controllers are used: the MKE standard, a proprietary controller and a type of IDE connection. Don't mistake the IDE connection for the common the 40-pin IDE plug to the IDE hard drive controller. The voltage signals often deviate by as much as 5 volts from IDE specifications, and thus can result in hardware damage.

Sound cards often come bundled into a 'multimedia upgrade package'. This package contains the drive, all the connection cables and software, and a guarantee that all the parts will work correctly with one another. It's usually a safe way to upgrade your computer system with a multimedia system.

Adapter card

A CD-ROM drive with an adapter card is the easiest, most reasonably priced solution. You buy a CD-ROM drive and the corresponding controller card for the drive. Installation is usually easy because the appropriate software is included. However, you will need an extra slot. Unlike SCSI controller cards, these more reasonably priced solutions use different, sometimes manufacturer-specific controllers. For example, Philips and Mitsumi use their own proprietary controllers. There are also some adapter cards that connect similar to IDE adapter cards.

Parallel connection

This type of connection is designed for devices without extra slots, such as notebook computers. Installation is seldom a problem in such cases because the controllers are a component of the device.

Most notebooks do not include SCSI interfaces. For these computers, you can use a parallel-to-SCSI adapter that will let you connect external SCSI devices to notebooks. Then you can connect a SCSI CD-ROM drive to the parallel port.

These adapters also let you use the parallel port for printing since the parallel to SCSI adapter replicates the parallel port.

An extra controller for the drive?

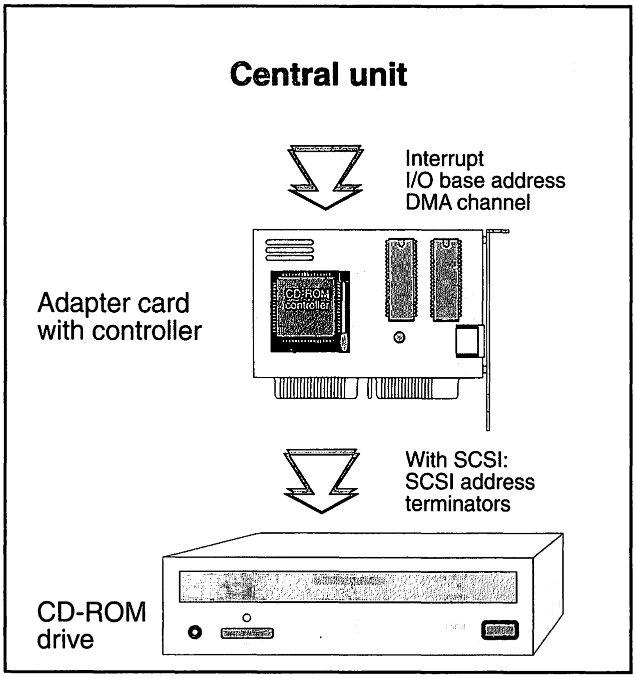
We can reduce all these cases to two basic types:

- SCSI controllers
- non-SCSI controllers

In most cases, you'll be connecting the CD-ROM drive to a SCSI controller that's already installed in your computer.

Installation & Configuration

You'll have to consider the following during installation: When using non-SCSI controllers, you're usually using a dedicated interface card specifically designed for the CD-ROM drive (see the following illustration).



The ports control the flow of information to the drive

What's in store for you

If you install an add-on controller, you'll probably have to configure it for your computer system. Configuring a controller involves setting an interrupt, I/O base address and DMA channel. More about this shortly.

It's not always necessary to configure the controller. Whether you need to configure your hardware depends on the number of add-ons already installed in your computer system. Any settings you make must be unique. You cannot have two devices with the same interrupt or the same address, for example. The more devices there are in competition, the more difficult it becomes to find unique values.

The more add-on cards you have in your system, the more likely you'll have a conflict in some of the settings. However, if you only have the basic components installed in your PC, it's quite likely you won't have to change any settings.

Installing The Hardware Components

As we mentioned, you have two options: Either install an add-on card and risk having problems with the controller settings or install a SCSI drive. On the basis of this knowledge, we have a step-by-step plan with a little more detail to it.

Step by step plan

Installation

Cable connections

Hardware configuration

Interface
Motherboard controller

Interface
Controller driver

Software configuration

Low-level driver

High-level driver

Tuning

After installing the CD-ROM drive (unless you have an external drive), you'll have to connect the cables. This is basically the same for all controllers. You connect a power cable, a data cable and an audio cable. The hardware configuration varies. If you install a controller at the same time, you will be configuring the controller interface. This normally also involves activating a controller on a sound card.

Installation & Configuration

From a technical standpoint, consider this controller as completely independent of the sound card. Therefore you'll also have to configure the controller on the sound card. In such cases you probably won't have any trouble with the controller drive interface. On the other hand, if you install a SCSI drive into a system with other controllers, you'll have to install the controller drive interface.

Despite all the differences in hardware configuration, the steps for software installation are identical for all systems. It's important to note, only the steps are identical; there is a big difference in the drivers which are used in software installation. After the low level drivers, you must link the high level drivers to the startup files of the operating system.

The final step of software configuration is optional. However, by fine-tuning your CD-ROM drive, you can increase the speed of access of your CD-ROM drive slightly.

Setting up the interface card

Before you can use the CD-ROM drive, you have to set up the adapter card, also called the interface card, to work in your computer system. Your system 'talks' to the controller on the interface card. To set up the interface card, you'll need to set two or more of the following:

- Interrupts
- I/O Base addresses
- DMA channels

Most interface cards require their own unique interrupts and I/O Base addresses and most interfaces are also affected by DMA channels. This is true regardless of whether it's the interface for the CD-ROM controller, the serial port to which your mouse is connected or any other interface.

Interrupts and IRQs

The central processing unit (CPU) in your computer system performs work that your application requires. When a hardware device needs to get the attention of the CPU, it 'interrupts' the CPU by identifying itself using an Interrupt ReQuest (IRQ). At this point, the CPU saves its current work and then services the IRQs.

The input from the keyboard which causes an interrupt and ultimately displays on the screen. The input of characters occurs simultaneously as they appear on the screen.

An interrupt is also used when you access a CD-ROM drive. For example, an interrupt request may inform the controller that data needs to be transferred. On the other hand, the controller could also enable an interrupt request to inform the processor that another data transfer is necessary.

The interrupts are numbered from 0 to 15. The processor recognizes which interface the interrupt requested based on the number. This only works if each device, i.e., each interface, has its own unique interrupt. You cannot assign two devices to the same interrupt. So to ensure that all your system components work correctly, you need to assign different interrupt numbers.

A few of the possible numbers are preassigned to the disk drive, hard drive and keyboard and other basic components. The remaining IRQs can be reassigned as your system is expanded.

The following table lists how the interrupt numbers can be assigned:

Interrupt IRQ	Assigned function	Interrupt IRQ	Assigned function
0	Timer	8	Clock
1	Keyboard	9	(VGA)
2	Interrupt Controller	10	(COM3)
3	COM2, (COM4)	11	(COM4)
4	COM1, (COM3)	12	Available
5	LPT2	13	Coprocessor
6	Disk Drive	14	Hard drive
7	LPT1	15	Available

We'll have to select an interrupt number for the new CD-ROM drive that is unused by the system. If two devices are assigned the same number, they'll interfere with each other. However, there are some exceptions in which you can indeed assign the same number to different devices.

The preceding table listing the interrupts and their assigned functions is only an example and may not be exact for all computers. This is due to the different length slots in which you plug the cards. A PC has short slots called 8 bit slots and long slots called 16 bit slots. When you use an 8 bit card, you can only address interrupts through to number 8. For example, this may be the case with the interface card. If your system has such an 8 bit interface card and you have two parallel ports (LPT1and LPT2) and two serial ports (COM1 and COM2), all the interrupts up to and including 8 are already being used. Now, you might have a problem if you have to add an 8 bit adapter card for your CD-ROM drive: You would probably need to disable one of the interfaces. However, you can assign an interrupt for a printer interface (normally a parallel interface) to another device as well. You see, as a rule, no interrupts are used when you operate a printer.

Most CD-ROM drives are preset to use number 5 set as an interrupt. In case LPT2 or if no other interface is using this interrupt number 5, you can accept this value without a problem.

What if this interrupt is already being used, for example, by a sound card? When using interrupts, give priority to interrupts of interfaces that are unavailable in your system. For example, if your system has COM1 but not COM2, then interrupt 3 is available.

Your next best option is to use interfaces that are available but not connected to anything. If COM2 is present but not used (your mouse may be connected to COM1 and therefore COM1 is always being used), you can use IRQ3 without any problem. This rule also applies when COM2 is linked to a device that doesn't use interrupts.

A third but more risky option is to assign an interrupt that is already assigned to another device. You must make certain the device seldom uses the interrupt or are certain both devices won't request the interrupt at the same time. If you use this option, we recommend not using the interrupt for the mouse, the sound card nor the CD-ROM controller.

In all three cases, you run the risk of no longer being able to address the devices which have the same assigned interrupt, or you may not be able to address them correctly.

Later in this chapter you will learn how to change interrupts, and you will also find out that practically every change you make to hardware is accompanied by a change to the software.

I/O base addresses

In addition to the interrupt number, you must also specify an I/O base address for each interface. This address specifies the beginning of what is usually a very small memory area. This is the area where data to and from the controller is passed back and forth. This entire address range is only 64K in size, and completely separate from conventional memory. Preferred I/O addresses for CD-ROM drives are 300h or 330h. The lower-case "h" at the end of the numbers indicates hexadecimal notation, which is common for specifications of memory size.

The following table lists a few fixed I/O base addresses in the system. They refer to the serial and parallel interfaces.

Interface	Address value in hexadecimal notation	Interface	Address value in hexadecimal notation
COM1	3F8	LPT1	378
COM2	2F8	LPT2	278
COM3	3E8	LPT3	3BC
COM4	2E8	11	(COM4)

Usually, these values do not conflict with the default values for CD-ROM drives. It's other installed devices, such as controller cards for tape drives or SCSI cards, that can affect these address ranges. There should not be a problem with the I/O address if you don't have any such cards installed in your system. Otherwise, determine the address values of the devices connected to your PC to eliminate the possibility of two devices using the same address range.

I/O address collisions are like collisions with interrupt numbers: they can paralyze the hardware components.

DMA channels

Basically, this should complete our discussion of data exchange between the central unit and add-on devices. Data, controlled by an interrupt, is exchanged in memory at the location specified by the I/O base addresses. However, there is one drawback. The I/O address ranges are only a few bytes in length each, and therefore turn out to be bottlenecks for data exchanges with the CD-ROM drive, where so much data is being moved.

An alternative way to provide for smooth, steady data transfer is called Direct Memory Access (DMA). With this method, data is transferred to and from the device directly through conventional memory. DMA data transfers are naturally much faster than transfers from the I/O base address.

Most CD-ROM controllers support DMA data transfer. Just as there are for interrupts, there are also different channels or signal lines for DMA, called DRQs (DMA request). The request for data transfer is transmitted through this signal line.

DMA channels 0 to 4 are mainly required for system internal functions. Channels 5 through 7 are available for the CD-ROM drive. As a rule, you won't need to change the default value of 5, unless you installed other expansion boards, e.g., for networks or tape drives that are controlled by these DRQs.

Another rule for the DMA channels is that each device should have a definite DRQ assigned to guarantee smooth operation. You'll also need to avoid double addresses, as you did with the interrupt settings.

Installation & Configuration

A SCSI configuration

When you connect a drive to an existing SCSI controller, you won't need to worry about interrupts, I/O memory areas and DMA channels. You do, however, need to configure the SCSI bus.

As we mentioned, you can connect up to seven additional devices to a SCSI bus. Each device gets a SCSI address so the SCSI controller can identify the device when it receives an IRQ (data exchange through I/O base memory areas) or a DRQ (data exchange through RAM directly). The SCSI addresses are numbered from 0 to 7. The number 7 is reserved for the host adapter, while numbers 0 and 1 are reserved for bootable hard drives. Therefore, we can use number 2 for the CD-ROM drive.

Besides the SCSI address, there's another important point to remember. After you have connected all the devices to the host adapter using the controller cable, you have a 'chain' of devices. You have to 'terminate' both the beginning and end of this chain with a small hardware device called a terminator. We'll tell you exactly where to place these terminators and how to do it later in this chapter.

The following parameters play an important role in the configuration of the SCSI bus:

- SCSI Address
- Terminators

Onto the installation

You must consider one more item before you pick up your screwdriver and begin the physical installation. A manufacturer's warranty usually becomes void when you open your PC case. If your PC is still under warranty, you may want to ask your dealer or contact the manufacturer as to whether installing an internal CD-ROM will void your warranty.

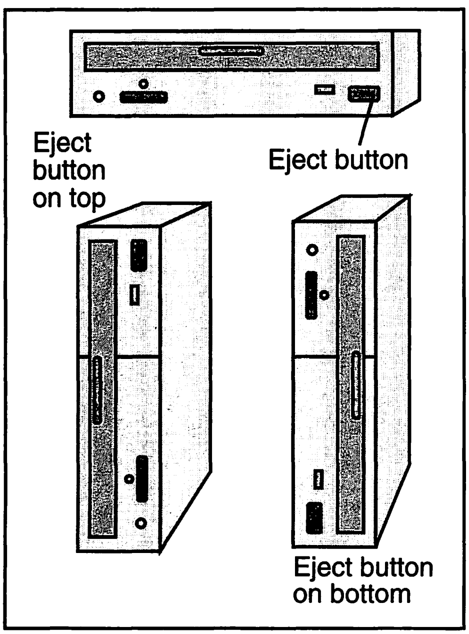
Now you can switch off the computer, unplug the power cord and open the case. First, locate an unused 5.25-inch drive bay and remove its front cover, which is often held in place by two small plastic clips. Then carefully push the CD-ROM drive in from the front. Later, you will secure the drive on both sides with two screws per side. In some cases you'll first have to mount drive rails.

Before continuing, you have a few preliminary tasks to complete. First, check to make sure that all of the cords are long enough. Also, find out if any hardware configuration is necessary, such as setting jumpers or dip switches. We recommend finishing these tasks before installing the CD-ROM drive. After installation, you will often have a very difficult time reaching the jumpers and DIP switches. Plugging in the cables is usually easier before installation.

If you're installing an interface card with the CD-ROM drive, you must first select a slot for the card. Refer to the schematic drawings in your manual, if available, for help in locating an available slot. However, it's easy to tell the potential slots for expansion boards: These are long sockets, some of which are already occupied by boards. Find a suitable slot for your card. Remember, there are short 8 bit slots and long 16 bit slots as well as 8 bit cards and 16 bit cards. It's best if you use a slot into which your card fits exactly. Although you can plug an 8 bit card into a 16 bit slot, the reverse is impossible. Before gently plugging the card into the slot, you need to unscrew the slot cover plate so the card has an outside connection. At the end of installation fasten the card to the case with the same screw you took from the cover plate.

Don't bother to reassemble your computer, even after connecting the cables, until your CD-ROM drive has passed the final function test. This doesn't happen until after you've installed the software, tighten only one screw on the drive and leave the case open.

If possible, choose a horizontal mounting bay for your CD-ROM drive. We recommend horizontal installation because there are only a few drives which will work in the vertical position. Consult your drive manual before installing the CD-ROM drive vertically. If you do decide on vertical installation, you should consider which side of the CD-ROM drive is on top. It's usually possible to install the drive only one way, for example, with the eject button on top (see the following illustration).



Different ways to mount a CD-ROM

Installation & Configuration

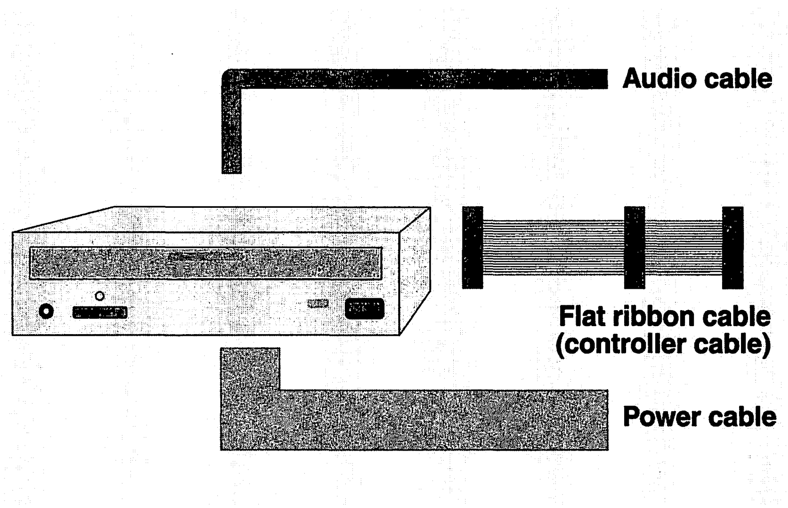
Place the drive in the bay horizontally (or vertically), making sure that it isn't tilted or slanted. If a drive is installed at an angle, centrifugal forces could put too much strain on the drive mechanism and eventually cause damage.

The right cable connections

You usually have three cables to attach to the CD-ROM drive:

- Audio cable
- Flat ribbon cable (also called controller cable)
- Power cable

3 cable connections to your drive



Power on - the power cable

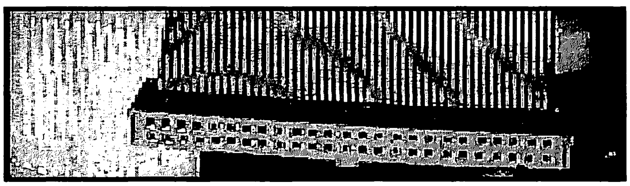
A four pin power cable supplies power to the drive. This cable is not included with the CD-ROM drive, instead, you'll have to find an unused connector from the power supply of your computer. This connector consists of a flat plastic plug with four small sockets.

If you cannot find an unused power plug in your PC, you can buy a Y adapter. This adapter has a four pin socket on one end and two four pin plugs on the other side. Simply unplug the power cable from an existing drive, plug it into the socket of the Y adapter, plug one of the Y adapter's plugs into the drive and you've got an unused plug.

When you plug in the cable, remember the plug will only go in one direction. Plugging the cable in wrong could damage the drive.

Flat ribbon cable

A flat ribbon cable provides connection between the drive and the controller. These data interface cables normally have 34, 40 or 50 leads (conductors). The following photograph shows a 50 pin SCSI cable.



A SCSI cable

This cable is normally attached to the drive, although it may be missing from the SCSI drive. In such cases, you'll have to find a free connection from the existing cables or you'll need an extra SCSI cable to make the connection.

It really doesn't matter how you connect the cable. You only have to consider the entire layout of the flat ribbon cabling during the configuration. You can plug the new cable into the second SCSI socket on the controller, to a second socket of a connected device and, theoretically, to a free connection on the existing cables.

When connecting the cable, avoid plugging it in the wrong way or you could damage the hardware. A small "nose" in the middle helps you with the SCSI cable.

A rule to remember for the other cables is one side of the flat ribbon cable is specially colored, usually red. This side of the cable always belongs at the position of the socket labelled Pin 0 or Pin 1.

Audio cable

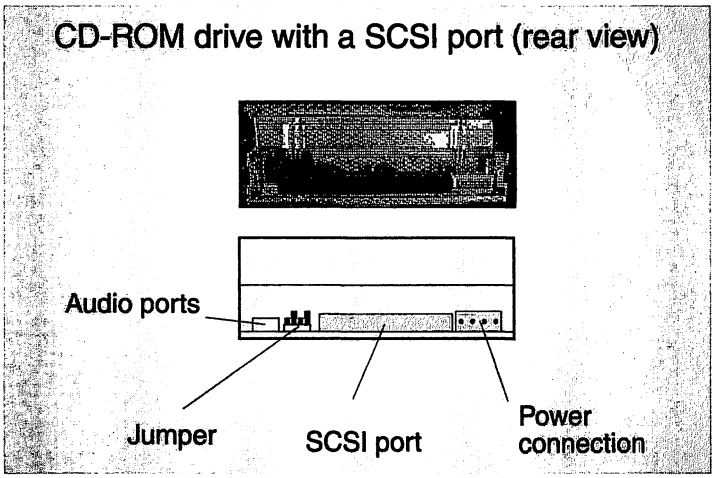
The audio connection cable is used to playback your CD-DAs. Your CD-ROM drive will then function as an audio CD player. Audio data is transferred directly to an amplifier. You have two possibilities of connecting the audio cable:

If you installed a sound card in your system, connect this cable to the CD-IN jack of the sound card. Then the audio signals will be played by the amplifier of the sound card. Otherwise, connect the cable to the controller card.

Note the jack on the rear of the controller card. You'll use this to connect the computer to an audio amplifier, such as a stereo. By the way, ADPCM signals are sent to the controller using the controller cable and processed there.

If your CD-ROM drive package doesn't include an audio cable, make sure you buy the right type of audio cable, i.e., one that will fit the drive, sound card or controller. There is currently no universal audio cable or any type of standard for audio cables.

The following illustration shows how the cable connections on the back of a SCSI drive should appear:



Cable connections

External devices

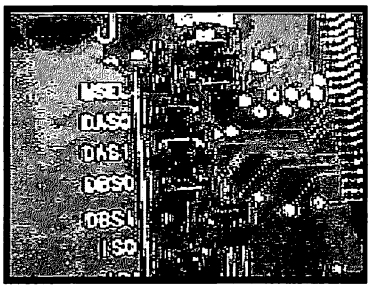
Although some external devices include an adapter card, you'll usually find external devices that are SCSI devices. Connecting the cables is easy for both types of external device. A power supply furnishes the power and one or two audio connections make direct connection to an amplifier possible. Only the flat ribbon cable has to be plugged into the external connection of the controller card.

If your external device has an adapter card, it's going to fit, no matter what. There won't be any problems with a SCSI device either: On the rear of the device you'll even find two 50 pin SCSI sockets. If the external output of the SCSI adapter is also 50 pin, you'll need a 50-50 SCSI cable, otherwise the output jack of the SCSI host adapter is 25 pin, in which case you will need a 25-50 SCSI cable. This cable is also referred to as a Macintosh SCSI cable because it is compatible with Apple Macintosh.

You will also have to attend to the correct configuration of SCSI addresses, etc. for external devices like you do with internal devices.

Hardware Configuration

The term hardware configuration refers to more than connecting the right peripherals with the right cables. Hardware configuration also refers to jumper and dip switch settings. For example, the following illustration shows the jumpers of a sound card.



Jumpers

You'll normally configure your hardware when the computer is switched off. Software configuration, however, is performed while your computer is switched on. Software configuration is about linking drivers. Although software configuration is performed after hardware configuration, leave the case open since it may be necessary to adjust the hardware settings.

Controller configuration: IRQ, I/O base address and DRQ

When you install a controller with the CD-ROM drive or need to configure an existing controller in the system, for example, the controller on a sound card, you'll have to set the interrupts, I/O base addresses and DMA channels.

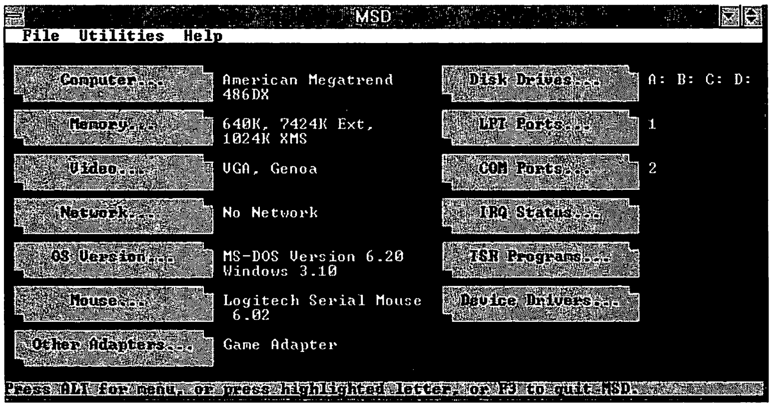
If you have a sound card which also contains a CD-ROM interface, you may need to enable that entire group of components by setting jumpers or DIP switches. With some sound cards that support several drive types or standards, you can set jumpers to determine the layout of the interface to the CD-ROM drive.

First, record the current configuration of your hardware before touching anything. It's possible you won't have to change any settings for the CD-ROM controller. You can use programs such as Check-It or utilities such as Norton Utilities or PC Tools to determine the current status of your settings. If you do not own or have access to these programs you can also use a program called MSD (Microsoft Diagnostics). To run the program, type:

MSD [Enter]

You can also run the program from Windows.

The program displays the screen shown in the next figure. Click the IRQ-Status button to display the current allocation of the interrupts.



The MS-Diagnostics screen

Although MSD displays important information, unfortunately it cannot determine how you set the interrupts for add-on cards. This is also true for the other diagnostics programs. If you didn't write down the values, there are different methods to help you determine these settings. Your AUTOEXEC.BAT file usually includes the proper settings for Sound Blaster cards and other sound cards. For example, you may see a line similar to following in your AUTOEXEC.BAT:

```
SET BLASTER=A220 I5 D1
```

The line has the following meaning:

- A220
  The I/O base address is 220h
- I5
  Refers to IRQ5
- D1
  Refers to DMA channel 1

To see the current values with other devices, i.e., tape drives, simply call the setup program of the device.

After finding out the values for the standard interfaces with the MSD program and determining the values for your installed add-ons, check the manual for your CD-ROM drive to determine whether there are conflicts with the default settings for the CD-ROM. If there are no conflicts, you're finished with hardware configuration and can start the software configuration.

However, there may be unavoidable conflicts, for example, if your sound card is already using the interrupt required by the CD-ROM controller. If so, you'll need to change the interrupt for the drive controller, i.e., to either 3 if you don't have a second serial port installed or to 7. You may also need to change the IRQ channels of other devices.

It's best to make a plan by entering all the desired values. Refer to the user manuals if you're planning changes for devices. You're looking for the limitations for each device. Remember, not all allocations are possible, for example, it may not even be possible to assign interrupt 7 for a controller.

Keeping I/O address ranges separate is easy. We'll review the rules for choosing IRQs and DRQs. You should use those values for interfaces which:

- Aren't present in your system
- Have no device connected to it
- Do have printers connected
- Are connected to devices which don't use interrupts

Configure two different devices with the same interrupt only in emergencies. Two different devices can share the same interrupt only when the two devices don't request the interrupt at the same time.

To change an interrupt for a device, you must first change the settings on the card. The following describes the different methods for changing the settings:

Some interface cards have EEPROMs, which are mounted on them. EEPROM is an acronym for Electrically Erasable Programmable ROM chips. You can change the settings for the card through the program. Any values which you change will remain in effect until you change them again. The advantage of this method is that you don't have to open your computer case.

More often, interface cards have jumpers mounted on them. You use jumpers to make contact between two pins. Basically, jumpers are small, attachable plastic blocks that are pushed onto the two pins to close a circuit. The disadvantage of this method is that you have to open the case and check the documentation to find out which jumpers are set and which ones have to stay open.

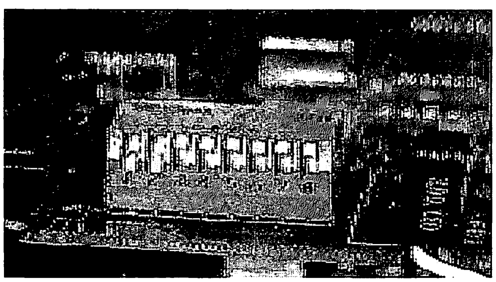
The pins on the card have labels, which are also in the documentation. In the documentation, a table or graphic gives information about which jumpers need to be placed to select a specific IRQ.

The following shows how a table may appear:

IRQ	IS1	IS2
3	on	off
5	on	on
7	off	on

You'll need to check the card for the pins labeled IS1 and IS2. Both jumpers are set if the factory setting for the interrupt is 5. If you want to change to 3, remove the jumper on IS2; to change to 7, remove the jumper on IS1.

Sometimes interface cards have DIP switches mounted on them to change settings. The best way to move these switches is with an ink pen.



DIP switches

Every time you change hardware settings of add-on cards, you must also change the software. Because you use drivers to address add-on cards, the drivers must know the IRQ. For example, if you changed the configuration of a sound card, you'll need to run the appropriate configuration program as you would if you changed the controller card of a tape drive, etc. This also applies to CD-ROM drives. When you're installing drivers during software configuration, you must respecify or at least confirm the values for interrupt, I/O base address and sometimes the DMA channel. We'll describe this in more detail in the section on software configuration.

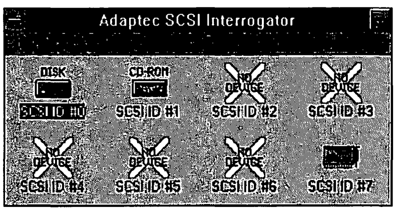
SCSI bus configuration

Once you've finished configuring the motherboard controller interface, the next step is configuring the controller drive interface, which primarily concerns the SCSI configuration. You usually won't have to do this type of configuration with other drive types.

However, as we mentioned, up to seven devices can be connected to SCSI controllers. An interrupt request for the host adapter needs a SCSI address or SCSI ID so it can be transferred to the correct device. This ID is specified in decimal numbers from 0 to 7. This applies to the full value SCSI host adapters, the smaller ones with a maximum of two connectable devices can only have two SCSI IDs, 0 and 1.

Each device has its own ID. Two identical address numbers would cripple all the components on the SCSI bus. Since the hard drive is also connected to the full value SCSI host adapter, this would mean that you could no longer access your hard drive.

The addresses 0, 1 and 2 with most host adapters are reserved for bootable drives. Address 7 is reserved for the host adapter itself. This leaves numbers 3 through 6 for CD-ROM drives. Before you begin assigning an address to a component, it's a good idea to look at the IDs that are currently set. The IDs are displayed on the screen, right before the operating system boots up. With the Adaptec SCSI controller, you can run the Adaptec SCSI Interrogator under Windows. You will see something similar to the screen in the following illustration. In our example, a CD-ROM drive with ID 1 has already been installed:



Adaptec SCSI Interrogator program

To assign this address number, you normally have to reset the jumpers. Refer to the appropriate documentation. Sometimes DIP switches are also used for this purpose. On external devices, you will often find rotary switches for setting the number.

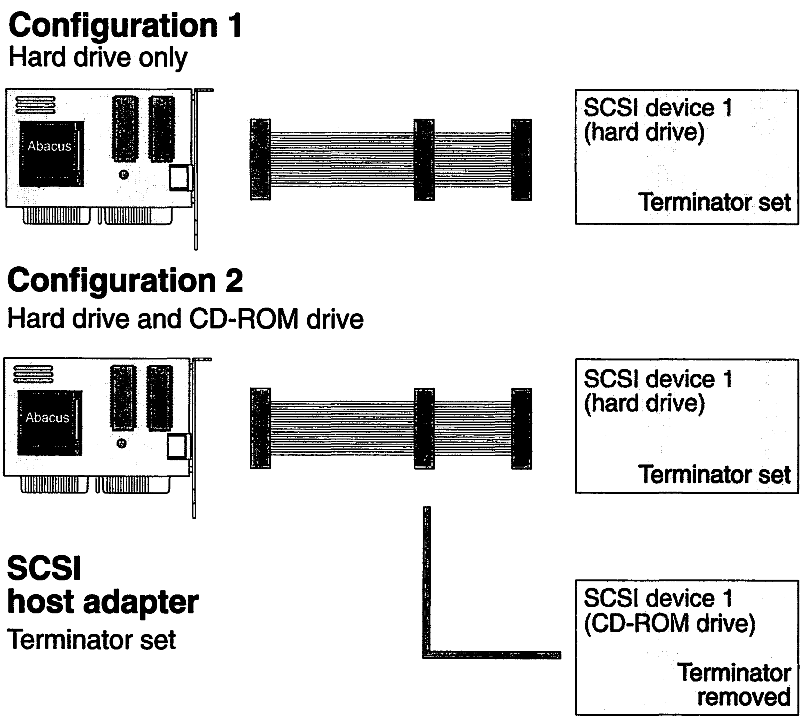
Regardless of the address numbers, you also have to set terminators. When you connected the cables, you connected the drive to the SCSI bus or unused port. The SCSI bus is prone to unwanted 'noise' on the cable, which in turn, interferes with the operation of the controller. This can lead to a breakdown of the components, i.e., the hard drive. To suppress noise on the signal lines, electrical resistors (terminators) are placed on the ends of these signal lines.

You'll see terminators occasionally used with other standards; at any rate, terminators are essential for the smooth operation of a SCSI bus. Since most mistakes are made with terminators, we'll show you some different cable setups.

First, the following basic rule applies: The terminators must be enabled for all devices located at the end of the SCSI bus. This also applies to the host adapter itself. If there are only two devices on the SCSI bus, each must be equipped with terminators. If you then use the middle connection of a SCSI line to hook up a new CD-ROM drive, you must disable the terminators there.

Even if there are only a few devices connected to the SCSI controller, we still recommend taking this business with the terminators seriously. Sometimes, incorrectly set terminators won't have any immediate or recognizable consequences. However, any hardware change to the system, even changes unrelated to the SCSI bus, can cripple the entire SCSI bus.

CD-ROM connection to SCSI bus: Configuration options 1-2

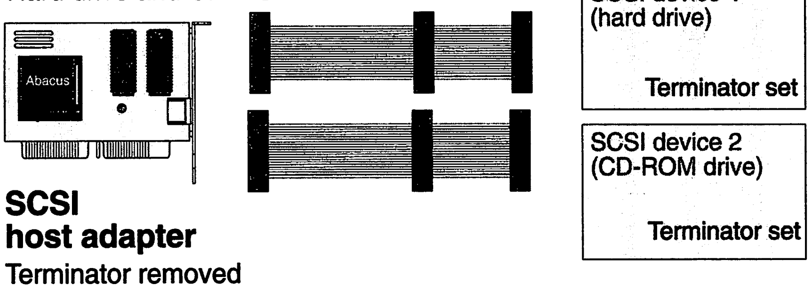


The situation is a bit different if you connect the new drive to the second SCSI socket of the controller. In this case, both devices (in our example, the hard drive and the CD-ROM drive) are at the ends, while the host adapter is in the middle. Set the terminators on the CD-ROM drive and remove them from the controller.

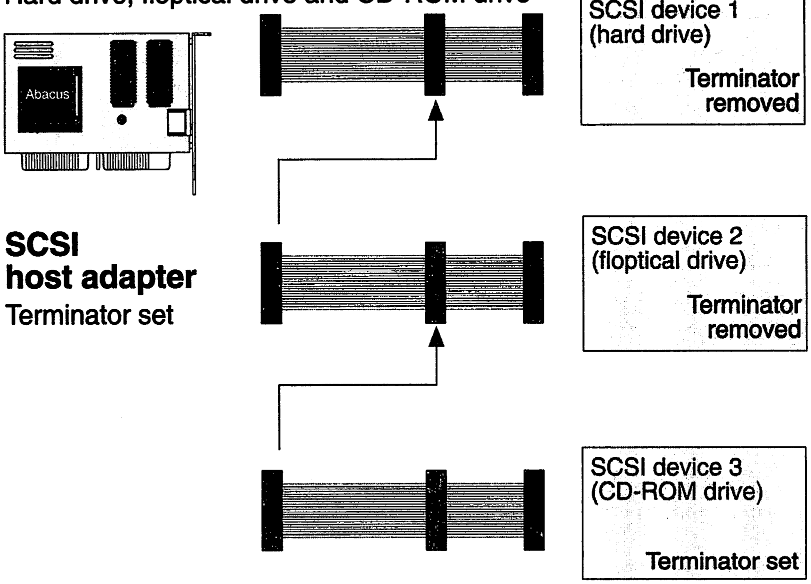
Remember, exactly two terminators will always be set, at the beginning and end of the chain. This is true regardless of the number of devices that are connected to the controller. Under no circumstances can there be more than two terminators set.

CD-ROM connection to SCSI bus: Configuration options 3-4

Configuration 3
Hard drive and CD-ROM drive



Configuration 4
Hard drive, floptical drive and CD-ROM drive

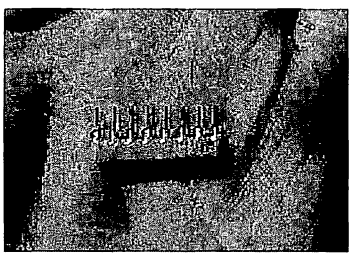


In practice, the rules for setting terminators on the components vary significantly. There are internal terminators on the cards that you can enable by means of DIP switches or jumpers. You need to check the documentation to find out which switches and jumpers enable the terminators.

Your documentation could have a table similar to the following:

SCSI-ID	Jumper 1	Jumper 2	Jumper 3
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1
1 = Set jumper 2 = Remove jumper			

To set the CD-ROM drive with SCSI-ID 2, remove jumpers 1 and 3 and set jumper 2.



Terminator plug

Sometimes there are ways with external devices to enable a terminator. For this case, insert a terminator plug in the unused SCSI socket. You can buy such a plug at your dealer's for about $5 to $10.

If you still cannot address a device, even if you're addressing it correctly and the SCSI bus has the correct terminators set, other possible errors include the following:

1. The power supply for the terminators can be a somewhat delicate topic. The SCSI bus includes a TRMPWR line (Terminator Power) for such cases. As a rule, this TRMPWR line is fed by the host adapter. However, connected devices still attempt to supply this line with power. Change a jumper setting on the board responsible to solve this problem. Set the jumpers for the TRMPWR line there to the Terminator Power option from the SCSI bus. This specifies that the host adapter will supply the power.

2. The flat ribbon cable can be another possible source of error. Keep this cable away from potential sources of disturbance, such as the power supply. The cable should be at least a few inches from the power supply. This distance should be even greater for external round cables.

3. A third source of errors is a jumper on the control card that you can enable or disable with Zero Wait State. Zero Wait State has to do with the access speed to the data of the drive. Normally, you should leave Zero Wait State active so there is no wait cycle. This ensures the fastest possible access. Do not disable this option until data transfer errors occur during operation of the CD-ROM drive. Wait cycles now occur, slowing down the transfer speed, but at least the drive is able to keep up.

Easy Software Installation

We have to install a few drivers before we can use the CD-ROM drive. Software drivers are the intermediaries between a peripheral device and the operating system. For example, the operating system doesn't have to know each command of the device. Instead, the operating system uses a standard command set which the driver translates for the specific device.

CD-ROM drives require several drivers from low-level drivers to high-level drivers. The low-level drivers regulate data exchange between the controller and the drive. The high-level drivers let you address a CD-ROM drive under DOS and Windows like other drives, for example a hard drive.

To play audio CDs from Windows, you can install another driver at a third level under Windows. We'll discuss this in Chapter 3.

Driver options

High-level and low-level drivers

High-level drivers	File presentation for DOS & Windows
Low-level drivers	Communication between controller and CPU

Low-level drivers are available from different companies that may use different names. These drivers are designed for a particular controller and its drive. The high-level driver is called MSCDEX.EXE (Microsoft CD-ROM Extensions). The MSCDEX.EXE driver is part of the operating system for MS-DOS 5, MS-DOS 6 and higher.

Installation & Configuration

Some CD-ROM drives already include all the drivers with the installation software. Use SETUP or INSTALL to run the installation software. The installation program then automatically links the low-level and high-level drivers. Remember to make backup copies of the originals before installation. Then store the originals in a safe place and use the backups for installation.

Low-level drivers

There are two types of low-level drivers:

- SCSI drivers
- Non-SCSI drivers

Special non-SCSI drivers, for example, as used with adapter cards or sound cards, come with the driver software, including the installation program. This installation software not only lets you install the low-level drivers, you can also use it to link the MSCDEX high-level driver, although the driver itself is usually no longer included. Instead, the installation program takes the driver from the MS-DOS directory.

Most drivers of the SCSI controller support all SCSI drivers, including CD-ROM drives. Also, Adaptec developed a standard called the ASPI standard. ASPI is an acronym for Advanced SCSI Programming Interface. This standard applies primarily to SCSI drives. Low-level drivers were divided into two types within this standard:

1. ASPI Manager (drivers for the interface to the controller).
2. Specific device driver for the specific drive.

The ASPI-Manager is usually included by the manufacturer of the controller. The specific device driver is supplied by the manufacturer of the drive. The ASPI-Manager for DOS that comes with the Adaptec 1542 controller is called ASP4DOS.SYS. Other controllers have different names. For example, Trantor's ASPI manager is called either MA13B.SYS or MA348.SYS.

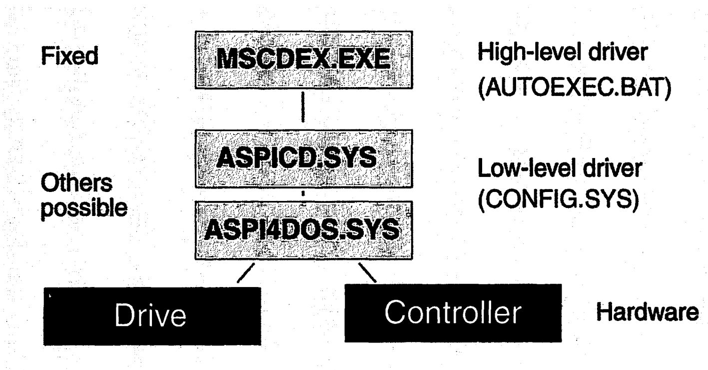
A general driver from the driver package for the SCSI controller can also be used as a device driver. Examples of general device drives include ASPICD.SYS from Adaptec and TSLCDR.SYS from Trantor. There's nothing wrong with using the driver that comes supplied with the drive.

Along with SCSI drivers, which come with the host adapter in the form of a kit,

You can purchase other driver packages which are usually more convenient to operate, contain drivers for other operating systems such as Unix, OS/2, Novell or Windows NT, and may even support more specific drives than the standard driver package. For example, Corel Systems Corporation has two such complete packages, Corel SCSI and Corel SCSI Pro.

Corel SCSI Pro is an especially important program package for CD-ROM users. The integrated CD-ROM cache program makes an increase in speed of up to 70% possible. Adaptec has released a collection of drive specific CD-ROM drivers called The Multimedia Connection. Unfortunately the cost of these packages is beyond what most users can afford.

At any rate, after installation, the driver calls have to be added to the DOS startup files. You can use either a standard driver package, a separate package or make the entries by hand: The low-level driver is located in the CONFIG.SYS file. Both the ASPI manager and the device driver are in the CONFIG.SYS if you use ASPI drivers. Add the call for the high-level driver, MSCDEX.EXE, to the AUTOEXEC.BAT file.



Driver hierarchy

Driver calls in CONFIG.SYS and AUTOEXEC.BAT

To reconfigure an Adaptec host adapter, call its configuration program. You do this shortly before booting the operating system by pressing Ctrl + A. After startup, the program expects you to confirm the current setting for the I/O base address. The next screen has a menu item called Configure SCSI which gives you the option of configuring a new device. The configuration program first scans the entire SCSI bus again and suggests the SCSI ID. Then it installs the low-level drivers. Then the program also installs the high-level driver, MSCDEX.EXE. You need to specify the directory in which this file is located. The low-level drivers are installed in the CONFIG.SYS file, while the high-level driver is in the AUTOEXEC.BAT file.

The following is a small section from CONFIG.SYS:

```
DEVICE=C:\SCSI\ASPI4DOS.SYS /D /P334
DEVICE=C:\SCSI\ASPICD.SYS /D:ASPICD0
```

The following is a small section from AUTOEXEC.BAT:

```
C:\SCSI\MSCDEX.EXE /D:ASPICD0 /M:12
```

Installation & Configuration

It's important to assign a reference name for the CD-ROM drive regardless of the type of installation you perform. Specify this reference name after the low-level device driver in CONFIG.SYS with the /D: option.

This applies to all device drivers and not only this special one. Specify the same name in the same notation for the high-level driver in AUTOEXEC.BAT after the /D: option. If you choose automatic installation, the program enters these names in the files for you, thus ensuring that the names will be the same.

Be very careful because you can make a mistake if you enter the driver calls manually or change the driver calls. The computer won't recognize your CD-ROM drive if you have two different reference names.

MSCDEX.EXE driver

The MSCDEX driver lets you address a CD-ROM like a read-only disk from DOS and Windows. The current version of this driver is 2.23. The MSCDEX driver performs the following tasks:

- Allocates a driver letter, e.g., E:, making it possible to access the CD-ROM drive from Windows and DOS.
- Translates the High-Sierra or ISO 9660 file system into the DOS file system.
- Plays audio CDs
- Allocates an interface for the programming of CD-ROM applications.
- Recognizes the CD sector format

Since the older versions often had problems cooperating with DOS, the following table lists the different versions:

MSCDEX.EXE	File size	
1.01	14,913	DOS 3.1 - DOS 3.3 No support for ISO9660, supports only High Sierra
2.00	18,307	DOS 3.1 - DOS 3.3 Supports ISO9660
2.10	19,943	DOS 3.1 - DOS 4.0 DOS 5 with SETVER
2.20	25,413	Windows 3.x - support DOS 3.1 - DOS 4.0 DOS 5 with SETVER
2.21	25,431	DOS 3.1 - DOS 5, Windows 3.1 Included with DOS 5
2.22	25,377	Included with DOS 6
2.23	25,513	Included with DOS 6.2

Versions 2.10 and 2.20 are not always compatible with DOS Version 5 and above. For example, you'll see the "Incorrect DOS Version" error message if you call MSCDEX version 2.20 from MS-DOS 5. If this happens, use the SETVER operating system command to avoid this problem. Certain programs, including MSCDEX, prompt for the current version of DOS for different reasons. The SETVER command makes it possible for MS-DOS 5 and above trick programs into believing it is a different DOS version. To do this, link SETVER as a driver in the CONFIG.SYS file:

```
DEVICE=C:\DOS\SETVER.EXE
```

DOS loads a table in which program names as well as the version number DOS reports to these programs are recorded. To view this table, enter SETVER with no additional parameters. You could even change the table with the following command:

```
SETVER MSCDEX.EXE 4.00
```

However, it is not necessary to do this with MS-DOS, only some IBM and Compaq versions of DOS require this command.

Calling MSCDEX.EXE

Here is the syntax for calling MSCDEX.EXE:

```
MSCDEX.EXE /D:<Driver> /L:Letter /M:xx /E /V /S
```

Here's what the MSCDEX options mean (based on Version 2.23):

Option /D

This is the only required option. The device driver (<Driver>) follows /D. This name must match the name you specified after the low-level driver in the CONFIG.SYS with /D. The name can be up to eight characters long, for example:

```
MSCDEX /D:MSC0001
```

If you have installed more than one CD-ROM drive, specify a /D option for each additional drive.

Option /L

Use this option to specify the desired drive letter. To use the letter E:, enter the following:

```
MSCDEX /D:MSC0001 /L:E
```

You could also specify G. However, in this case, LASTDRIVE=G must be entered in your CONFIG.SYS file. Without this entry, DOS only supports letters up to E.

If you call the driver without using this option, MSCDEX automatically chooses the next free drive letter.

Option /M

Use this option to determine the number of sectors MSCDEX uses to buffer its data. A sector comprises 2,048 bytes. We recommend the following values: 10-20.

Option /E

Choose this option to place the sector buffers used by MSCDEX in expanded memory. Doing this saves conventional memory. However, before doing this, make sure you have expanded memory. Here's what the entry for expanded memory looks like in the CONFIG.SYS:

```
DEVICE=EMM386.EXE RAM 64
```

This entry sets 64K of expanded memory, which is the smallest possible value. You should not, however, use the entire 64K for the MSCDEX buffers. If the sectors, which are 2,048 bytes in size, are swapped to an EMS with 64K, it would result in a maximum value of 32. We don't recommend this value because it involves a large amount of internal memory management. The maximum, and in this case optimum, number would be 20.

Unfortunately, MSCDEX doesn't support sector buffering in Extended Memory.

Option /K

This is a foreign option that allows MSCDEX to read files in Kanji format, the characters used for writing in Japan.

Option /S

This option has been available since version 2.22. /s comes from the word share and releases the CD-ROM drive for servers in Windows for Workgroups networks.

Option /V

Displays configuration and memory statistics when MSCDEX starts.

Location of MSCDEX in AUTOEXEC.BAT

The location of MSCDEX in AUTOEXEC.BAT is important. You should load the network drivers before MSCDEX in the AUTOEXEC.BAT file. All calls for SMARTDRV should follow MSCDEX. Shell programs should be at the end of the file. Use the LOADHIGH command to load MSCDEX into upper memory:

```
LH MSCDEX.EXE /D:MSC0001 /L:E /M:20 /E
```

Troubleshooting

After you finish installing the hardware and software, you're ready to run your first test on the drive. Insert a normal CD-ROM in the drive and display its directory using either the DOS DIR command, the DOS Shell or the File Manager in Windows. You can assume the drive is running correctly if the screen shows files and directories. Then you can finally tighten the screws on the drive, card and case of your PC.

Don't be discouraged if your CD-ROM doesn't seem to work...it may be a simple problem that you can fix quickly. First, check all the cable connections. Make certain the plugs are seated tightly and are plugged correctly into the right connections. Make certain the drive is being supplied with power. Check to see if the cables are damaged, kinked or cracked. Is the controller cable too close to the power supply?

If you don't find anything wrong with the cable connections, look at the software configuration. Check whether the driver files specified in CONFIG.SYS and AUTOEXEC.BAT are actually in the right directory. Check whether the correct drivers are installed and are called in the proper sequence. The CONFIG.SYS file should keep the following order:

- HIMEM.SYS
- EMM386.EXE
- CD-ROM Low-Level Drivers

In case you installed low-level drivers compatible with the ASPI standard, the following sequence should be observed:

- ASPI Manager
- HIMEM.SYS
- EMM386.EXE
- CD-ROM Low-Level Drivers

A few questions you must ask yourself include the following: Is the call for MSCDEX.EXE in the AUTOEXEC.BAT file? Is the drive name specified with the /D: option identical to the one after the low-level driver? Did you make any typing errors when you entered the calls for the drivers?

If you don't find anything wrong with the cable connections or the software configuration, you'll need to check jumpers and DIP switches. Are the settings on the controller card correct? Do all the jumpers and DIP switches have the correct settings? Do the values match the ones you specified or confirmed in the low-level driver? As a rule, you'll have to remove the controller card again.

If all the settings are correct, check whether there's a conflict with an interrupt, I/O base address or DMA channel somewhere in your system. Run the MSD program again and go through all the installed add-on cards and their settings.

The problem could be, if you have a SCSI drive, an incorrect address number assignment or the wrong terminators.

If, after checking all these items, your CD-ROM drive still doesn't work, put your computer back together exactly as it was before you installed the CD-ROM drive. Repeat the entire installation (perhaps the next day). It's possible you overlooked something small the first time you installed the CD-ROM drive that won't matter the second time around.

Although defective hardware is a rare problem, it still occurs. If you've tried everything we suggested and installation still doesn't work, contact your dealer.

Tuning

Tuning your CD-ROM involves a principle that you are already familiar with from hard drives: The principle of caching. Cache memory has been used for a long time with hard drives to speed up access to them. Cache memory consists of defined memory areas that are usually in extended memory. The most recent data read from the drive is preserved in cache memory for a short time. The next time you access this data, it can be placed at your disposal much faster. Along with this type of caching, referred to as read caching, there is another type of caching called write caching. This technology is a bit risky. Data to be written is also placed in the cache for temporary storage until the processor has time to write the data to disk. However, in our dealings with CD-ROMs we won't be concerned with write caching, at the most, we'll be dealing with read caching.

The SMARTDRV command (through MS-DOS Version 6.0) supports both the read and write caching. Unfortunately, SMARTDRV didn't work with CD-ROM drives because conventional drives, such as hard drives and disk drives transfer their data directly from the BIOS (Basic Input Output System) while various drivers are involved with CD-ROM drives. Because of this flaw in SMARTDRV, special cache programs are now on the market: To name a few, there's CD Speedway, Lightning for Windows, Super PC-Kwik, and Norton Speedcache+.

While all these programs are practical, in DOS Version 6.2 developers enhanced SMARTDRV with the ability to cache CD-ROM drives. SMARTDRV's caching ability has performance stats that are every bit as good as those of the other special cache programs.

If you have DOS 6.2 installed on your system, you can cache your CD-ROM drive with SMARTDRV. If you have an earlier version of DOS, you can at least make the most out of the driver call for MSCDEX.

With MSCDEX you can specify the number of sectors to be placed in temporary storage using the /M option. This is also a type of cache memory. We said before that 20 is the ideal value. Here's what the call might look like:

```
MSCDEX /D:MSC0001 /M:20
```

In principle, conventional memory is used for buffer memory. If you set up expanded memory, you can also have sectors buffered there. To do this, add the /E option to the call:

```
MSCDEX /D:MSC0001 /M:20 /E
```

Setting up an expanded memory area for buffering sectors is only a good idea if you are really short on conventional memory. To do this, add the following line to the CONFIG.SYS file

```
DEVICE=EMM386.EXE RAM 64
```

This sets up 64K of expanded memory.

If you have DOS 6.2, you can drastically reduce the number of sectors with MSCDEX. SMARTDRV is much better at buffering data than MSCDEX.

SMARTDRV doesn't have to be linked to the CONFIG.SYS file. On the contrary, it is a normal program that you can start from DOS. Enter

```
SMARTDRV
```

without specifying any parameters to display the current status of SMARTDRV on the screen. The version number is included in the display. Versions 5.0 and above are able to place CD-ROM data in temporary storage. Enter

```
SMARTDRV /S
```

to determine whether the CD-ROM drive is correctly supported by SMARTDRV.

It's a good idea to add the call for SMARTDRV to the AUTOEXEC.BAT file. SMARTDRV must be called after MSCDEX.EXE. Otherwise there won't be any buffering of the CD-ROM drive. Adding SMARTDRV to the AUTOEXEC.BAT file (in the right spot) automatically enables cache memory for your CD-ROM drive. It's not necessary to specify any other parameters.

Ultimate Drive Test: CDCHECK

You can test the performance data of your CD-ROM drive with CDCHECK. It also displays technical information on your drive, the CD currently in the drive and the installed drivers. Finally, the program lets you play audio tracks.

One important feature of the program is the function for running comparison tests. It includes functions for saving and loading test series and for printing test results.

CDCHECK lets you set the parameters for the performance tests in a very precise manner. Since there are so many possibilities for testing, only a flexible program gives you extensive options for comparison. You can duplicate almost all known tests with CDCHECK.

It's on the companion CD-ROM

You'll find the CDCHECK program in the \CDCHECK directory.

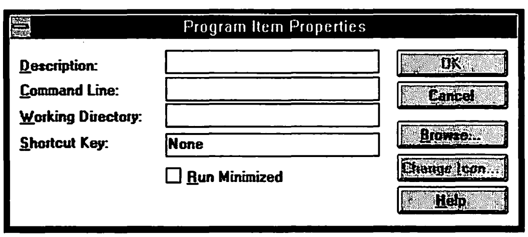
Before starting CDCHECK

You can run CDCHECK directly from the CD or from the hard drive. The only requirement is that you copy the program configuration file (CDCHECK.INI) to the Windows directory.

To link the program to a group in Windows Program Manager, follow these steps:

Enable the Program Manager and open group window you want to contain the program icon for CDCHECK. Now choose **New** from the **File** menu. The "New Program Object" dialog box appears. Select the **Program Item** option and click the OK button.

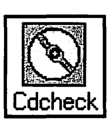
After that, the "Program Item Properties" dialog box appears. You will need to make some entries in this dialog box.



Program Item Properties dialog box

You can enter up to 40 characters of text in "Description:". This description will appear under the program icon in Program Manager. In our case, we'll use CDCHECK as a description. The "Command Line:" contains the actual program call. Enter the drive letter (CD-ROM drive or hard drive), a colon, a backslash (\) and the program name - CDCHECK.EXE. For example, if the drive letter is D you would enter: D:\CDCHECK.EXE. After that, click OK to close the dialog box. The program icon is now part of your Program Manager.

Program call



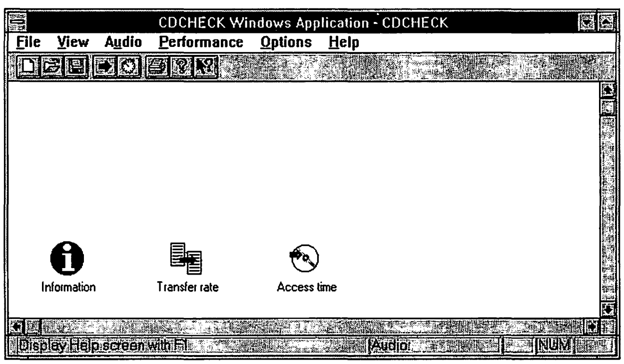
Click on the CDCHECK icon or the CDCHECK.EXE file in the CDCHECK directory of the companion CD-ROM.

If you forgot to insert a CD ROM in your drive, a message window brings this to your attention. A message window will also appear if you forgot to install a CD audio driver.

The message window

This is almost a sure sign that the MCI audio driver hasn't yet been installed. If this is the case, confirm the message window by clicking [OK], press [+] to exit the program and call the Control Panel from the Main Group to install the MCI audio driver. Once in Control Panel, choose Drivers to install the necessary drivers. Chapter 3 gives you a step-by-step description of the procedure.

CDCHECK environment

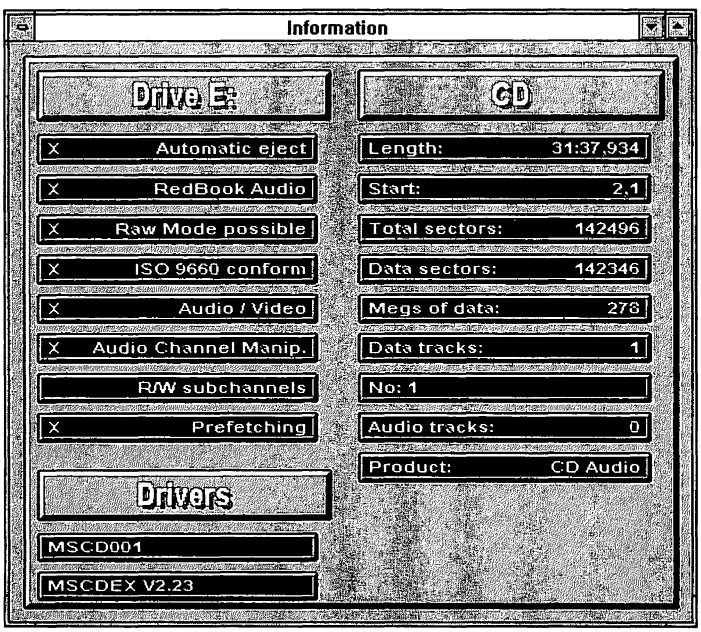


Program environment

When the program starts up, the CDCHECK desktop appears with three icons, representing the test options. You can click the Info icon immediately, however, the dialog boxes for the Transfer Rate and Access Time tests are still empty.

Data on the drive and the CD ROM appears in the information window. First of all, the first drive letter appears. Then comes a list of technical features. Features with an X next to them are the features your drive supports.

Automatic Eject	Drive supports automatic eject by software.
Red Book Audio	The drive is able to play audio CDs.
Raw Mode possible	Software programs are able to access the bytes for error detection and correction.
ISO9660 compatible	CD-ROM drive is compatible with ISO9660 standard.
Audio/Video	Drive can read audio and video information.
Audio-channel Manipulation	The allocation between information in the audio channels - substructures within the audio range - and the audio outputs can be manipulated.
R/W Subchannels	The drive supports R/W subchannels (e.g., for MIDI or graphic CDs)
Prefetching	Prefetching of sectors is possible



Information window

Below this information you will find the labels for the low-level and high-level drivers under Drivers.

The following status messages about the inserted CD:

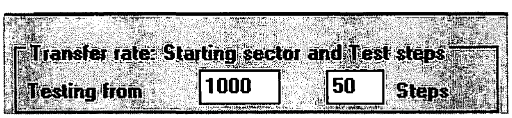
- Length in minutes, seconds and 1/1000th seconds
- Specifications about the starting position of the first track
- The number of whole sectors
- The number of data sectors
- The capacity in megabytes, which can be calculated by multiplying the number of sectors times the usable data per sector
- The number of data tracks
- The number of data tracks on the CD
- The number of audio tracks
- Readout of the CD-ROM product index

To scan the drive parameters again, choose the **Reread Data** command from the **File** menu or press [+].

Testing the data transfer rate

To determine the data transfer rate, click on the appropriate arrow button in the Toolbar, press [+] or choose the **Test Transfer Rate** command from the **Performance** menu.

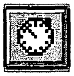
CDCHECK reads 16 consecutive sectors during the test, i.e., 16 x 2,048 = 32,768 bytes several times. Then the program divides the number of kilobytes read by the number of seconds, obtaining the data transfer rate in K/s. The program even allows you to specify the number of cycles, in other words, how often the program reads 16 sectors, as well as the start sector. To do this, choose the **Settings** command from the **Performance** menu.



The transfer rate section

Specify the desired value for the start sector after "Read from sector" and specify the number of cycles before "Sectors". In the example, CDCHECK starts at sector 1000 and reads 16 sectors 20 times.

Testing access times

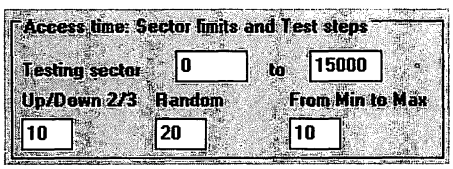


To start the series of tests, click the clock in the Toolbar, press + or choose the **Test Access Time** command from the **Performance** menu.

CDCHECK determines three different access times. The first test for access time is 1/3-2/3 access time. CDCHECK alternately reads sectors at the beginning and end of the middle third of the data on the CD. The second test determines access times for randomly selected sectors, while the third test determines access times for those sectors farthest apart from each other. You can change the settings for all three tests.

The 1/3-2/3 test

You can set the number of cycles for the 1/3-2/3 Test. To do this, call the **Settings** item from the **Performance** menu. For this test, the only important specification is To/From. Specify the number of cycles here. Setting a value of 10 results in the following actions: First, starting from the end of the first third of the data on the CD, the program reads a total of ten sectors, at intervals of 13 sectors. The interval of thirteen sectors is intended to simulate a movement of the read head from the inside of the CD to the outside. Then the program reads ten sectors backwards from the end of the second third of data on the CD, also at 13 sector intervals. This is designed to simulate the movement of the read head from the outside of the CD to its inside. So setting a cycle means that the program reads a total of 20 sectors.



Settings for Access Time

Random selection of sectors

Another test value is the result of randomly selecting sectors. You can choose the test range in which the program reads the sectors as well as the number of accesses. To do this, choose the beginning and end sector in the "Settings" dialog box (choose **Settings** from the **Performance** menu) as well as the number of accesses under **Random Distribution**.

Min-Max test

You can also set the test range for the Min-Max test, as you did with the random test. Specify the number of changes below From Min to Max. The sample value of 10 means that the program switches between the upper and lower sectors ten times, reading twenty sectors.

Managing the test series

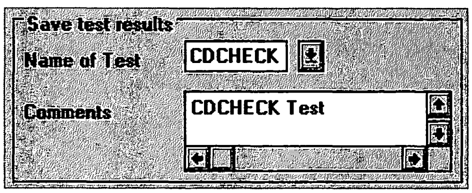
In the **File** menu you will find commands familiar from other applications for managing files. Choose **New** to open a new test series file, deleting all the results displayed up to now. The **Open**, **Save** and **Save As...** commands let you load and save files. The default extension for saved files is "DAT". The four previous files are executed in the menu and can be loaded by clicking them.

Choose the **Print** command to put the results of your test on paper, use **Print Preview** to view the results on the screen, and choose **Printer Setup** to set the printer.

Creating new test series

You can create custom files with test series from several drives and add to the DRIVE.DAT file saved on the CD-ROM. For example you could add values from your CD-ROM drive to the file.

To create a new test series, call the **Settings** command from the **Performance** menu.



Saving the test results

After that, click on the downward pointing arrow to open the "Name of Test" listbox. This listbox can contain up to ten test series. Choose the first free entry that you wish to overwrite. Now change the name by typing over it and entering a comment. Then exit the dialog box by clicking OK.

You can save a total of ten test series per file. You can run comparisons between different drives in an easy to survey format. Each test series gets its own name and can include a commentary. The name is specified in single value ranges and indicates the name of the tested drive. You could list (enter) the hardware environment as the commentary, which also affects the test results.

The name can have up to 10 characters, while the commentary can include up to 256 characters.

Configuring CDCHECK

The **View** menu lets you hide or show the status bar at the bottom of the screen and the toolbar. Each element being displayed has a checkmark next to it.

The **Options** menu offers other options for configuring the representation of the data and the program flow.

Sound on

This setting lets you switch sound support on and off while the program is running. CDCHECK is supported by sound output in specific places. You can switch playback of default sounds on and off in the Options menu. You can also change the sound allocation. To do this, either replace the default Wave files with your own or change the allocations in the CDCHECK.INI file. You can specify custom sound files after events, if necessary, linked to path specifications.

Save Tests

Specifies whether the test results are to be saved.

Save Settings

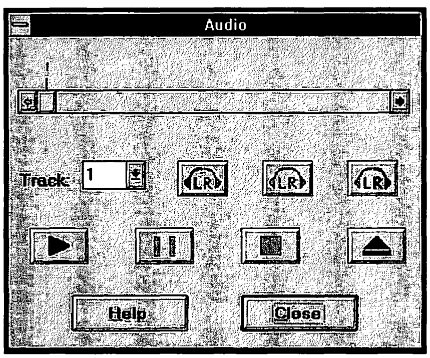
Specifies whether the program settings (color, font etc.) are to be saved in the INI file.

Color Palette

Makes it possible to set colors separated by display areas.

Playing audio CDs

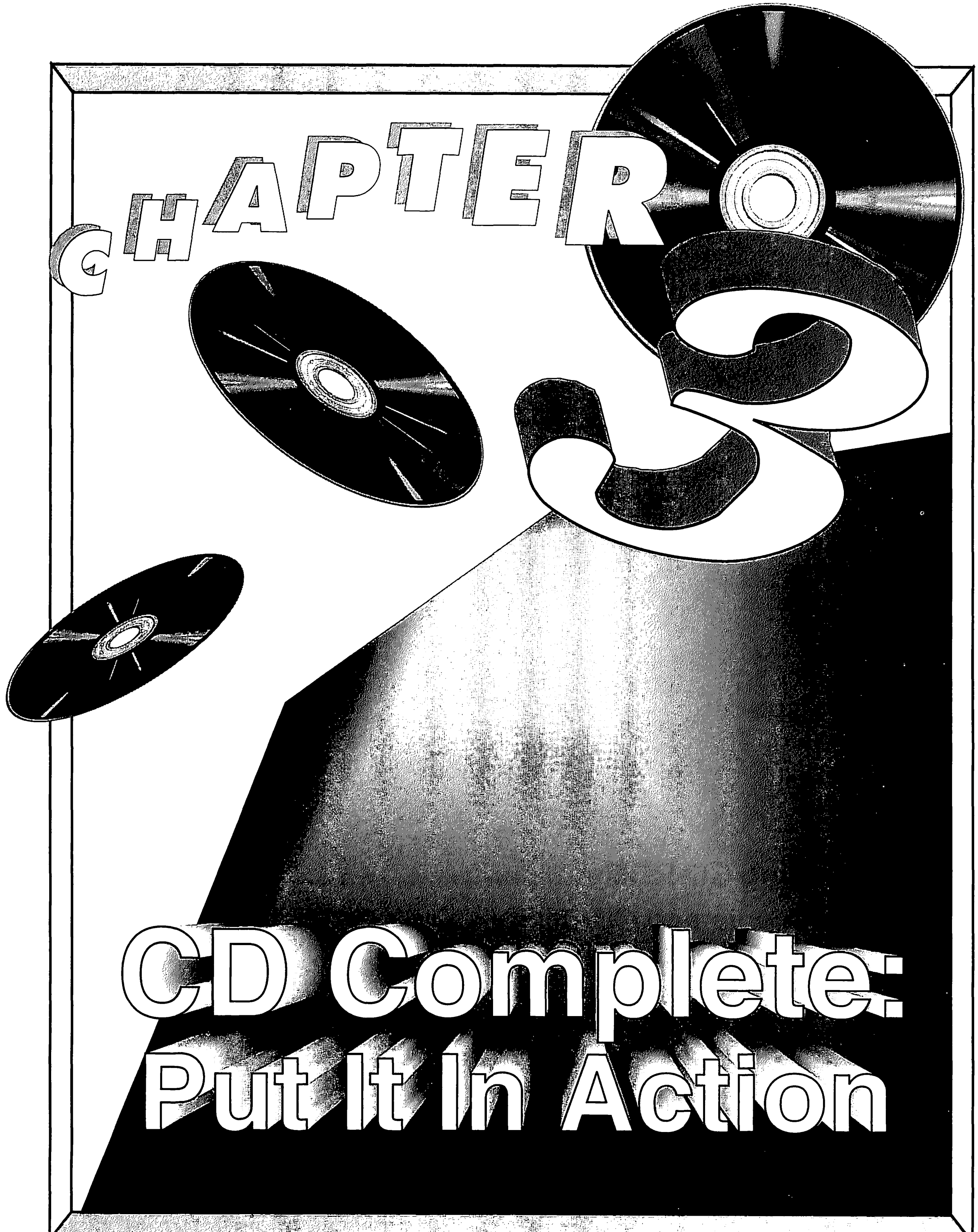
If you inserted a CD-ROM with audio tracks or an audio CD into your drive, the Audio item will be available in the menu bar. Click the **Play CD** option to open the Audio dialog box.

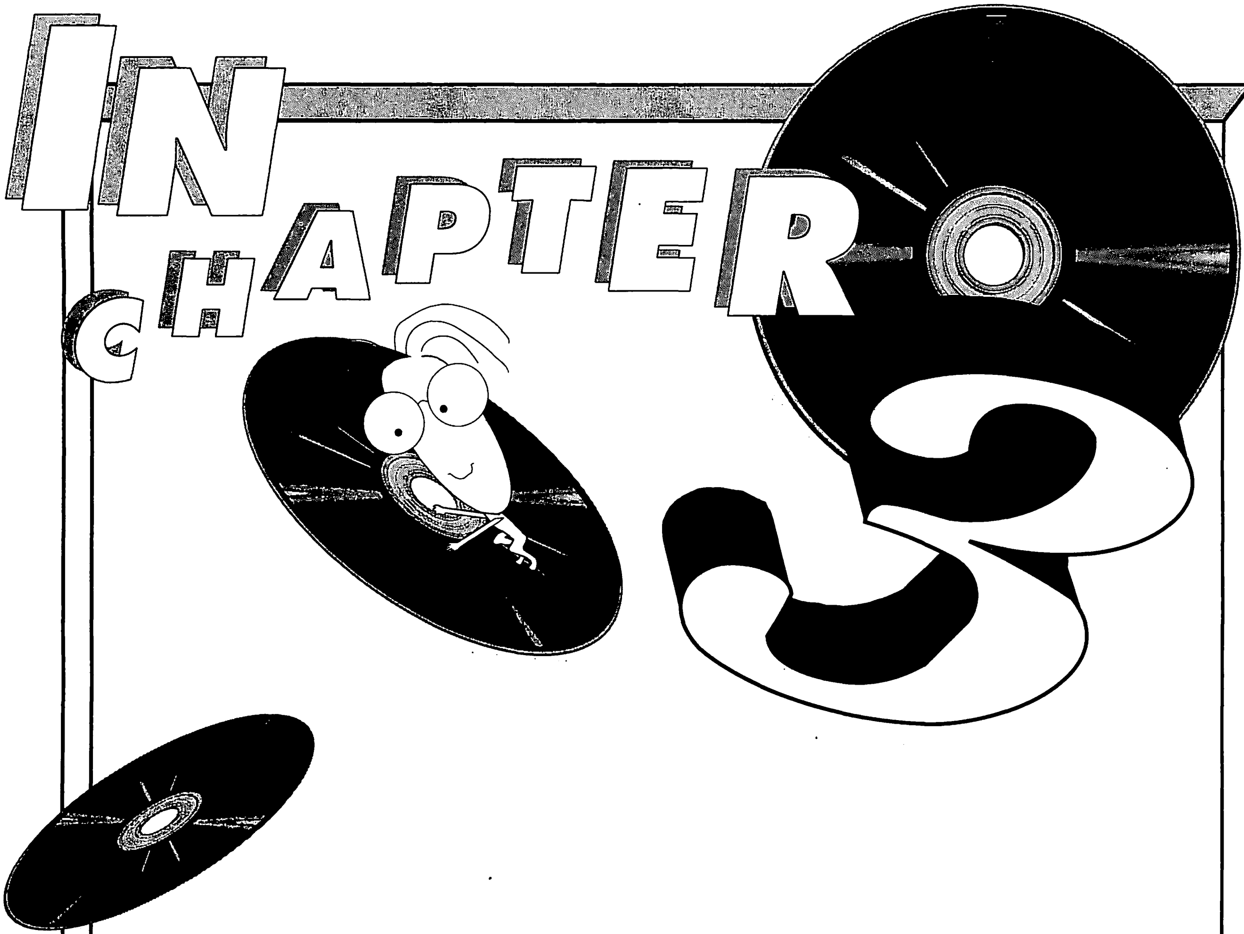


Audio dialog box

To select a track, either use the scroll bar or select a track from the "Track" listbox. Next to the listbox you will find switches/buttons for selecting a channel. For example, you could open the left channel, but leave the right channel locked. Below the listbox you will find the normal controls for playing audio CDs.

If you choose **Audiotest** in the **Audio** menu you can perform an audio test on the inserted CD. For a description of this test, please see Chapter 3.


CHAPTER
3
CD Complete:
Put It In Action


IN CHAPTER 3

3 CD Complete: Put It In Action 3

In this chapter we'll discuss two of the hottest topics today: Multimedia and PC video. We'll explain multimedia and its technology including sound cards. We'll also discuss how to install and use CD-ROM based software. Another section describes the Photo-CD technology. We'll start by telling you how to handle your CD-ROMs properly.

Handling CD-ROMs

Despite their apparent durability and hard surface, you should be careful when handling CD-ROMs. Scratched or otherwise damaged areas, even small ones, can have irrecoverable effects - far worse than similar damage on audio-CDs. In this section we'll discuss a few guidelines which you should follow when handling CDs.

It's a good idea to touch or handle only the outer edge of the CD-ROM. Never touch or handle the bottom, or reflective side, of the CD. Fingerprints can interfere with the scanning process - in addition, oils from the skin can damage the material and allow dust to accumulate quickly.

If you use a caddy, as we recommended earlier, make certain to insert the CD correctly. Place the CD-ROM into the caddy with the mirrored side facing down. Note the sliding shutter at the bottom of the caddy. It opens upon insertion and exposes the bottom of the CD-ROM for scanning. The CD should sit level inside the caddy, with the hinged side below the plastic tab. When using a caddy, be careful not to insert the CD-ROM backwards!

The caddy's shutter should be fully engaged prior to insertion. With auto-loading drives, insert the caddy only about three-quarters of the way, until you feel a resistance. With a slight push the caddy will insert automatically.

Before removing the CD-ROM or caddy from the drive, make certain the drive light is off. If the drive light is still on, the scanning laser is still working. Although the drives are designed so laser beams are not harmful, it's wise to take this precaution anyway.

CD Complete: Put It In Action

What to do when your CD is unreadable

You should protect your CDs from moisture, dust and sunlight. If dust has settled on a CD, or it has become unreadable, first try to clean it with a dry, lint-free cloth. Wipe the CD starting from the inside and continuing to the outside edge. You can usually purchase special velvet cloths for cleaning CDs at audio stores.

If cleaning the CD doesn't work, you might try a "repair kit", also available at audio stores, to restore the CD. Unfortunately your chances of restoring the CD at this point are not very good. Your last option is to contact the dealer or manufacturer and to request a replacement CD. Many companies will exchange a damaged CD for a nominal fee if you first return the original CD.

Multimedia and CD-ROM

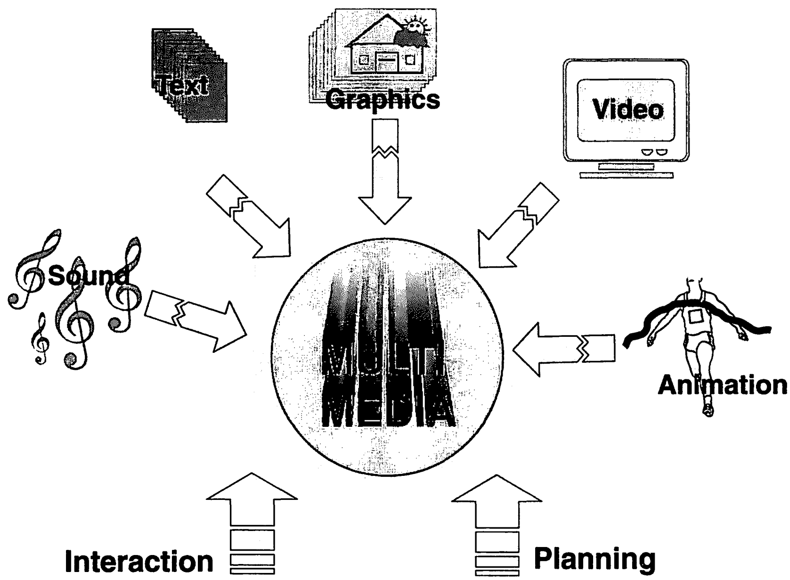
You'll seldom discuss CD-ROM drive technology without hearing the term "multimedia." Along with the sound card, CD-ROM technology has greatly expanded the capabilities and excitement of the PC. These new capabilities are collectively referred to as multimedia. The CD-ROM applications we'll describe in the next section are also considered multimedia.

What is multimedia?

First however, we'll need to try defining the term multimedia. Unfortunately, defining multimedia is not an easy task. Because of the explosive interest in multimedia, many manufacturers want to call every program a multimedia program and every device a multimedia device.

Actually there are several criteria for defining multimedia in the PC world. Literally, "multi" means many and "media" refers to a carrier or medium. Multimedia therefore combines various media including text, graphics, sound, video, and animation. However, simply combining them is not enough. According to this definition, playing an announcement with any piece of music would qualify as multimedia. A steady stream of media which constantly changes is confusing at best. The first criterion for multimedia then is coordinating the various media according to a definite plan and purpose. We can also say that multimedia is the integration of different media.

There is a second criterion, however. The viewer should not be watching a multimedia presentation passively like he or she would watch a film. Instead, the user should be able to control or have some affect over the multimedia presentation. For example, certain events can be selected while others are ignored or the entire sequence changed. Participation such as this by the user is called *interaction* - the user can affect program execution *interactively*.



Multimedia components

We mentioned several practical applications for this type of arrangement in Chapter 1. Teaching and information systems are ideal for CD-ROM and therefore also for multimedia.

Multimedia technology

Now that we know the end results of multimedia technology, we'll discuss the system requirements. If you want your PC to run multimedia, your PC must have at least the following two items:

Sound card	Required for high-quality reproduction of music and sound, especially of digital speech.
CD-ROM drive	Essential for its large storage capacity.

CD-ROMs provide the vast storage capacity needed for videos and sound. CD-ROM also supports sound in the form of DA-tracks and, within the framework of the XA format, sound stored with other data in interleave format.

MPC - the Multimedia PC

Microsoft, working with other companies, has developed the MPC standard. This standard lists the components, with their specifications, for a true multimedia PC system. The MPC standard was developed within the Multimedia PC Marketing Council and serves as a kind of seal of quality. A PC

following these specifications can now be called an MPC (Multimedia PC). No independent body exists to determine multimedia capability; rather it is the manufacturers themselves who decide whether a particular PC conforms to the standard.

By establishing the MPC standard, customers now have a relatively standardized access to multimedia devices under Windows. Also, software is being developed specifically for the different MPC levels. Therefore, some software may not even run on a non-MPC computer. The first MPC standard was developed in 1989. Its original version included the following specifications:

MPC Level 1 - 1989	
Processor	Minimum 80286 / 10 MHz frequency
Memory	Minimum 2 MB RAM
Diskette drive	3.5-inch / 1.44 Meg
Hard drive	Minimum 30 Meg
CD-ROM drive	Minimum data transfer rate of 150K/sec Average access time under one second
Processor load during data transfer from CD-ROM drive	Maximum processor load is 40% at a transfer rate of 150K/sec from the CD-ROM drive
Audio capacity of CD-ROM drive	The CD-ROM drive must support audio-CDs and mixed-mode CDs and have a volume control
Sound card	8-bit sound card
Monitor	16-color with screen resolution of 640 x 480 pixels
Software	DOS 5.0 or later and Windows 3.0 or later with Multimedia Extensions CD-ROM driver, compatible with MSCDEX Version 2.2
Other	101-key IBM-compatible keyboard 2-button mouse Parallel and serial ports Joystick port MIDI-interface

The minimum requirements of MPC Standard Level 1 are a sound card and a CD-ROM drive. All the specifications listed fall within the lower range of performance standards for 1989. No special capabilities are needed for the CD-ROM drive since it was typical of the technology at the time (data transfer rate of 150K/sec and access time below one second). Furthermore, most drives support audio- and mixed-mode CDs. An interesting fact however is that even a fully-utilized CD-ROM drive could use only 40% of processor capacity. This is one requirement that many drives had difficulty meeting. In this respect we

were left somewhat in the dark, since on the one hand the appropriate test programs were available only to drive manufacturers, while on the other hand only these manufacturers could determine MPC capability.

Level 1 of the MPC specifications was later updated concerning the processor. As an intermediate step, starting in 1991 an MPC had to have at least a 16-MHz 386SX processor. In 1993 the MPC standard was officially revised and took on the name MPC Level 2:

MPC-Level 2 - 1993	
Processor	Minimum 80486SX / 25 MHz frequency
Memory	Minimum 4 Meg RAM (recommended: 8 Meg RAM)
Diskette drive	3.5-inch / 1.44 Meg
Hard drive	Minimum 160 Meg
CD-ROM drive	Minimum data transfer rate of 300K/sec Average access time 400 ms XA- and multisession capability
Processor load during data transfer from CD-ROM drive	Maximum processor load is 40% at a transfer rate of 150K/sec from the CD-ROM drive. Maximum processor load is 60% at a transfer rate of 300K/sec from the CD-ROM drive
Audio capacity of CD-ROM drive	The CD-ROM drive must support audio-CDs and mixed-mode CDs and have a volume control
Sound card	16-bit sound card
Monitor	65,536-color (64K) with screen resolution of 640 x 480 pixels. Video resolution 320 x 240 pixels at 256 colors and 15 frames per second
Software	DOS 5.0 or later and Windows 3.0 or later with Multimedia Extensions CD-ROM driver, compatible with MSCDEX Version 2.2
Other	101-key IBM-compatible keyboard 2-button mouse Parallel and serial ports Joystick port MIDI-interface

The current MPC specifications more reflect today's technology than earlier specifications. Requirements are especially high for individual components such as sound cards. Certain components that were previously MPC-compatible no longer qualify, for example CD-ROM drives with a 150K/sec data transfer rate. Likewise certain software, designated as MPC2 software, might not run on the old systems.

A new feature in this MPC specification is the quality requirements for videos. We'll discuss this further in the next section.

Music of the future: XA as multimedia standard?

Although MPC Level 2 has a CD-ROM/XA compatibility requirement for drives, it does not require the full XA Standard. The multimedia of the future will probably require even greater resources. There is every reason to believe that the next step will involve the complete set of XA specifications. In other words, virtually all CD-ROM drives currently with XA capability will have to be outfitted with an extra XA controller, which incidentally costs about as much as the drive itself. Only with an XA controller will you then be able to read nested files and decode ADPCM audio data. In the more distant future, "Phase 3" of the XA Standard, which also includes specifications for video compression, may become the definitive standard for Multimedia PCs.

Now that we have explained the term multimedia and discussed its possible evolution, we can move on to practical uses for CD-ROM. Its major areas of application are video, sound and Kodak Photo-CD.

Using/Installing CD-ROM Based Software

The first question you'll need to answer when installing software which is on CD-ROM is whether to install the software on the hard drive and run it from there or to use the programs and data directly off the CD-ROM.

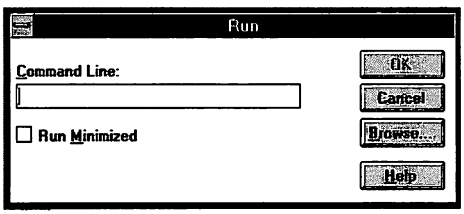
We recommend you leave files which you seldom use or those which you'll use only in special circumstances on the CD-ROM. Examples of files which should remain on the CD-ROM include libraries, collections, clip art, reference works, etc. However, you should install programs or applications from CD-ROM to your hard drive so you can run the programs or applications from the hard drive.

Although the disk space required by many programs today is large, most of these programs have the option of loading directly from the CD. An example of this approach is CorelDRAW! from Corel Systems Corporation. You can perform a conventional hard disk installation (requiring approximately 36 Meg of space), or set the program up to start directly from the CD-ROM. Although you must still copy

a few files to your hard drive, the overall disk space which CorelDRAW! requires is much less. The disadvantage of using this method of software installation is that you must insert the CD in the drive each time you want to use the program.

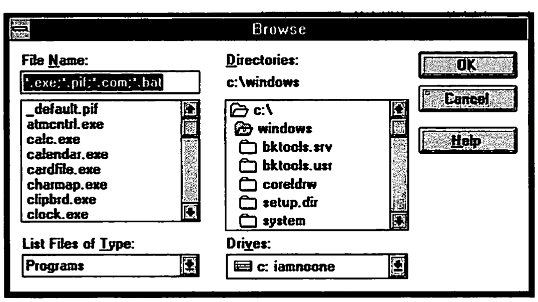
Practice: CorelDRAW!

You must be running Windows before you can install any Windows programs or applications. To do this, select the **Run** command from the **File** menu in either the Program- or File Manager.



Running a file under Windows

Type in the name for the program you want to run (with its pathname). If you don't know the name of the program or application when installing programs, click the Browse... button and search through the Files window.



The Search option

The Search window contains a total of five windows or list boxes and three buttons. First, click the Drives window and select the letter for the CD-ROM drive. In our example this would be D:. When you click on the "D" the list box closes and the drive letter D appears in the scrollbar. At the same time Windows switches to the CD-ROM drive, which in this case contains the first CorelDRAW! CD-ROM. The file and directory displays also change. "File Name:" now list the programs in the main directory of the CD and "Directories:" lists all immediate subdirectories.

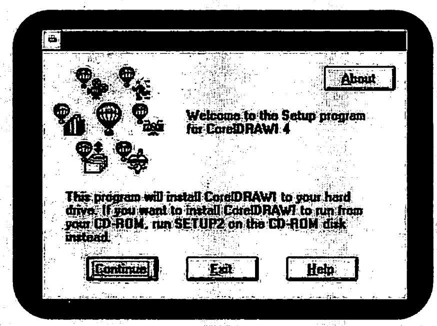
At this point the installation procedure would be the same for any program. Normally you would look for a program called SETUP.EXE or INSTALL.EXE. In our case we have a few additional programs, most notably SETUP.EXE and SETUP2.EXE. You can now decide what type of installation you wish to perform. For the normal hard disk installation, use SETUP.EXE.

CD Complete: Put It In Action

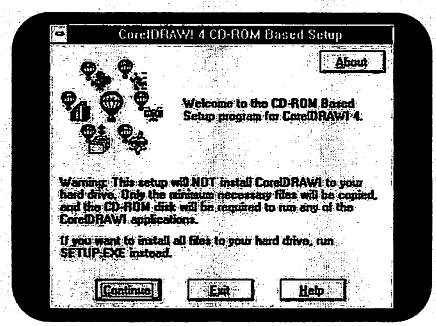
Running CorelDRAW! on CD-ROM

You can also install CorelDRAW! on CD-ROM. To do this click the SETUP2.EXE file once and confirm with OK. The program name will appear in the command line of the Run window, along with the drive letter of your CD-ROM drive. Close this window with OK and the installation routine will begin. This installation installs only the essential files to the hard drive.

Two different methods to install CorelDRAW!: Hard drive and CD-ROM drive



Installing CorelDRAW! to the hard drive using SETUP.EXE



Installing CorelDRAW! from the CD-ROM drive using SETUP2.EXE

The CorelDRAW! installation message window informs you on what will happen with either setup procedure you select. You also have a final opportunity to cancel the entire installation. If you continue and install CorelDRAW! on the CD, you'll save a lot of space on your hard drive although you'll still need your hard drive to save your CorelDRAW! graphics and files. For a C: hard drive the program installs the following four directories:

- C:\COREL40
- C:\COREL40\AUTOBACK for automatic backup copies.
- C:\COREL40\CONFIG for CorelDRAW! initialization (*.INI) and registration (*.REG) files.
- C:\COREL40\MOVE for the MOVE Player.

The installation procedure also updates the WIN.INI, PROGMAN.INI and REG.DAT Windows files. Finally, several programs, for example 22 DLL files and 3 additional files, are transferred to the Windows System directory.

CD-ROM And Sound

In addition to using WAV and MIDI files, a CD-ROM drive also lets you play audio-CDs and store the audio tracks in appropriate formats. You must have a sound card with the appropriate software installed on your computer before you can use sound with your CD-ROM.

The Sound Blaster standard

A sound card is not only for musicians, game users, or multimedia presentations. By using a sound card, you can enhance even simple application programs and business graphics. Like CD-ROM and other PC components, the sound card has a history of steady development, starting in 1987.

The first sound card, called the Game Blaster, was sold in 1987 by Creative Labs. This card was replaced in 1989 by Sound Blaster V1.0. Creative Labs then started a series of developments which eventually became today's standard for PC sound. This standard was reached when other sound cards followed both the Sound Blaster's technical capabilities and its compatibility-standard.

Despite this, the significance of the Sound Blaster standard (Sound Blaster compatibility) has recently diminished. Windows 3.1 requires the sound card producer to provide the corresponding Windows drivers instead of the software manufacturer supporting particular sound cards. Therefore, the number of different makes of sound cards now available has increased dramatically. To help you in selecting and using a sound card, we need to explain a few technical concepts.

Digital technology

When you listen to records and tapes in the past you were hearing analog technology. For example, audio information on an LP is represented by a groove moving in a certain direction. The analog process transfers data continuously onto the plastic platter. Digital technology instead records discrete values at predetermined time intervals. In digital recording, the sound samples are presented as a description of an event at certain points in time. As the interval between measured values decreases, the quality of the recording increases, becoming more realistic. When the measured values are stored as values, you can accurately reproduce the piece as many times as you like without losing any sound, fidelity, etc.

By using an A/D converter (ADC, analog/digital converter), you can convert an analog input signal to a digital output signal. The A/D converter measures the incoming signals at equal time intervals, compares these signals with an internal value table and assigns to them certain numerical values. The frequency with which an A/D converter measures the signals is called the scanning rate or sampling rate. In the PC world the word "sample" refers to digitized audio signals. By "sampling" we mean digitizing the audio data.

As we mentioned the A/D converter is required to store analog sound digitally. We'll also need a D/A converter or DAC (digital/analog converter) to convert the digital data back to an analog signal prior to playing.

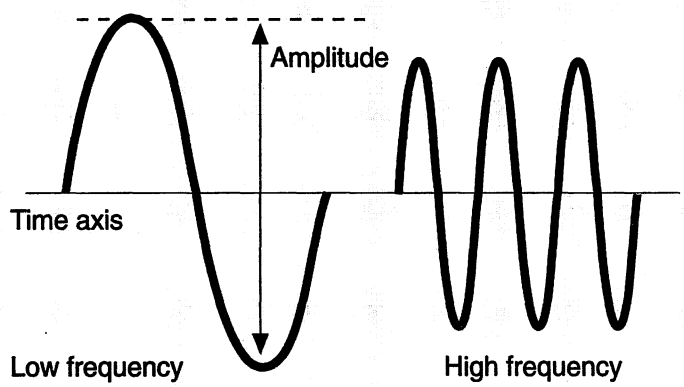
Sampling rate

Finally, the quality of the recorded signal depends not only on the sampling rate but also on the number of values available for coding. This number is usually called the resolution. For example, if in a sampling procedure the available values are 0 to 15, we speak of a 4-bit resolution. With resolutions, as in many other areas, we use the measuring unit: Bit. The principle behind this is based on powers of 2: 4 bits (2 to the 4th power) for a total of 16 values, 8 bits (2 to the 8th power) for 256 values. A sample recorded with 8 bits is clearly superior to a 4-bit sample. At 4 bits there are noticeable differences from the analog original, while at 8 bits the results are quite acceptable.

When choosing a sound card you should look for a good sampling rate. High quality sound cards provide a sampling rate of 16 bits per channel and a resolution of 44.1 kHz. This means the signal is scanned 44,100 times per second. These values are comparable to those of an audio-CD.

Synthesizers

Another important criterion for sound cards is their capacity to generate artificial, or synthesized, sounds. A popular addition to sound cards is an FM (Frequency Modulation) synthesizer. To illustrate the principle of frequency modulation, remember a sound simply consists of a small wave form or a sine wave - more accurately stated, an overlapping of several sine waves. The number of oscillations per second is called the *frequency*; the maximum wave height is called the *amplitude*.



Representing sound as a sine signal

Frequency modulation uses several sine generators. A sine generator produces a sine-shaped wave form. The wave generated by the first sine generator is overlaid by a second wave and is thereby modulated. By adding several sine waves, you can generate new and more complex wave forms. Theoretically, any sound is possible because any desired wave form is possible. The first sine signal is modulated in its frequency, hence the term FM. Since FM synthesis is relatively complex, some sound cards have an extra chip called the OPL chip (developed by Yamaha) for this purpose. The types of OPL chips include the OPL2, OPL3, and OPL4. The number indicates how many operators (sine generators) being used.

Wave tables

The newest generation of sound cards takes a somewhat different approach to quality sound generation. The basic principle is quite simple. Instead of using an FM synthesizer to generate sound, individual digitized sounds are stored in Read Only Memory (ROM) chips. Playback basically involves retrieving the data, converting it with a DAC and then amplifying it.

However, there is already one problem with this process. The ROM on a memory card would never be enough to store all pitches from several instruments. Therefore, the only sounds that are stored are the basic notes from each sound, whose pitch and tone are later matched. This task is performed by a digital signal processor (DSP).

One consequence of this technique, where sounds are sampled differently for different sound cards, is a large difference in sound quality among various products. Also due to limited memory space, the number of available instruments must be limited as well, if no additional RAM exists for loading further samples.

CD Complete: Put It In Action

DSP card specifications

WaveTable memory	Memory available for samples (normally between 512K and 4 Meg) either ROM only or with additional RAM into which further sounds can be loaded.
WaveTable samples	Number of samples stored in memory.
Instruments	Number of playable instruments.

There are no limitations on the number or types of instruments you can play with a sound card based on FM synthesis. You can generate virtually any existing sound by using the proper programs. Even so, based on performance and quality features, WaveTable or DSP cards emerge as the clear choice.

Sound cards and MPC standard

In addition to a sampler and a synthesizer, sound cards have many other components. Much more is required to comply with the MPC standard. The MPC standard places high demands on sound cards, and since several multimedia applications are based on the sound card, you should always look for the MPC logo when purchasing a sound card.

An MPC sound card must meet the following specifications:

- It must be MIDI-compatible, i.e., it must have an internal MIDI-interface and a connection for an external MIDI device.
- The card must have a microphone input.
- The card must have a "mixer" function, so you can adjust individual CD or synthesizer sound tracks separately and set their levels in relation to the total. This way the signals are truly mixed. We'll discuss programs that allow you to do this later in this section.
- Sampling rates of 11.025 and 22.05 kHz must be available at a resolution of 8 bits. Again, a sampling rate of 11.025 kHz means that the signal is scanned 11,025 times per second. However, the recommended sampling rate is 44.1 kHz at a resolution of 16 bits. Furthermore, the load on the microprocessor during sampling of natural sounds is limited to 10% of maximum capacity at a sampling rate of 22.05 kHz, and 15% of maximum capacity at a sampling rate of 44.1 kHz.
- Finally, the sound card must have an amplifier.

The Voice and Wave formats

Sound samples are stored in the PC in various formats. The most common formats are the Voice file, which is the standard DOS format (files with a .VOC extension) and the Wave file, which is the standard format under Windows (files with a .WAV extension).

The Voice format was developed by Creative Labs for the Sound Blaster card. A Voice file consists of a header, as a kind of introduction, and the actual data area. The data area is divided into several sub-blocks. A Voice file can be compressed by using the ADPCM audio coding.

Wave files basically contain the same data as Voice files, but in a different order. For conversion between formats, most sound cards include the WAV2VOC and VOC2WAV programs. The WAV2VOC program converts WAV files to VOC files and the VOC2WAV program converts VOC files to WAV files.

Optimal sound under Windows

You can use your CD-ROM drive as an audio player if you would like to listen to music while working with Windows. To actually make this work there are two requirements:

1. You must have an audio cable connecting the CD-ROM drive to an amplifier.
2. You must install the CD audio driver.

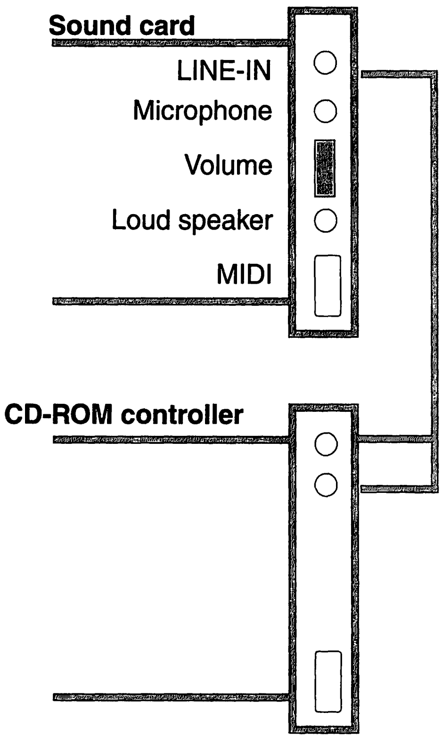
Where is the audio cable ?

If you have installed your CD-ROM drive correctly (as described in Chapter 2), you will have an audio cable that connects with the outside world. Either - in the case where you have a sound card, the audio cable has been connected directly to the internal CD-IN jack on the sound card. Or - in a system without a sound card, the audio cable is plugged into the corresponding jack on the controller. From there a connection should exist with an amplifier such as a stereo system.

At this point you may encounter the following problem. Since no standards exist for internal audio cables, you may have difficulty finding a cable suited to both the drive and the sound card. If you have purchased the drive and controller together, with the audio cable, the audio cable will fit into the controller jack but might not fit into the sound card. So, if you attach the audio cable to the controller, the CD-DAs cannot be reproduced using the sound card.

CD Complete: Put It In Action

There is a little trick you can use here however - the data can be brought to the sound card through an external 3.5-millimeter cable. To do this connect the jack at the back of the controller to the LINE-IN jack on the sound card (see illustration). If necessary you can achieve the same effect by connecting the LINE-IN jack on the sound card with the headphone output of the CD-ROM drive (at the front of the drive).



Cable connection between sound card and CD-ROM

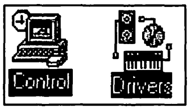
[MCI] The CD audio driver

Before you can begin listening to your audio-CDs, you have to load a driver. A special driver program is necessary to provide access to audio-CDs similar to how graphic cards and printers are also controlled by drivers.

This special driver is called the *MCI driver* (Media Control Interface). It provides a software interface between Windows and various multimedia devices. Its purpose is to simplify and standardize the control of devices under Windows.

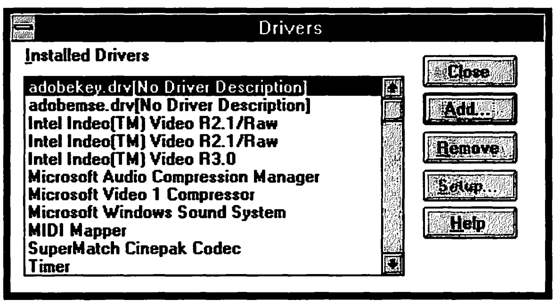
MCI drivers are sometimes included with multimedia hardware and some are already included in the Windows software package. Although the audio-CD driver for MPC-compatible CD-ROM drives is provided with Windows, it's not installed automatically.

Installing the MCI audio driver



In the Windows Program Manager in the Main group, if you open up the Control Panel you'll see icons for several setup programs. Use the Drivers icon to install the MCI driver.

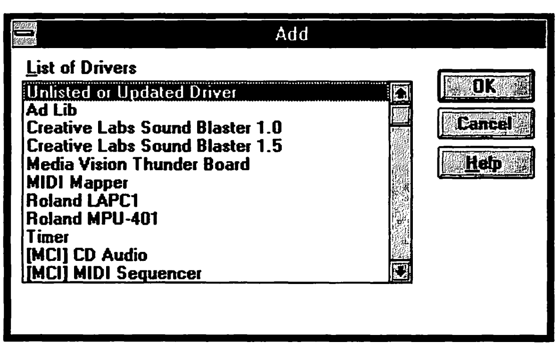
Double-clicking the icon opens the installation program. A long list of installed drivers appears. Scroll downwards with the side scrollbar until you reach the end of the list, where any previously installed MCI drivers are located.



The Drivers window

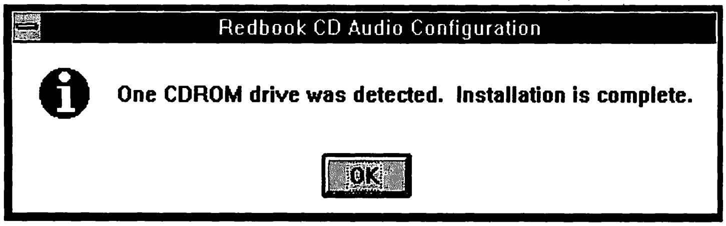
The drivers listed have been installed automatically by various setup programs, such as the one for the sound card and Windows itself. The MCI audio-CD driver is normally not installed however, it may even be missing from the list. If it is listed, press the [Cancel] button and continue.

If you do need to install the driver, click the [Add] button. You'll see the different MCI drivers at the end of the list of drivers. This is where you'll find the CD Audio Driver.



Adding a driver

Once you select this driver and close the window with OK, you'll be prompted to insert one of the Windows diskettes. From this diskette Windows uses this diskette to copy the MCICDA.DRV driver to the hard drive and makes the appropriate entries in the Windows initialization files. Finally, the program checks whether a suitable CD-ROM drive exists, and if so confirms this with a message.



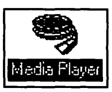
The Close window

If you do not see this confirmation message, and you're certain that you've installed the drive correctly, it could be the low-level driver of your CD-ROM drive is incompatible with the standard MCI driver of Windows. In this case, however, the driver diskette that comes with the CD-ROM drive should have its own specific version of the MCI audio-CD driver. Install this driver by following the steps we described; however, instead of selecting a driver from the list, click Unlisted or Updated Driver, insert the diskette and then click OK.

Playing your CDs

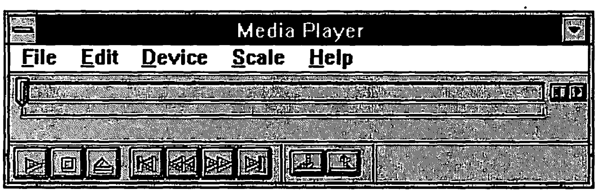
After you've installed the driver, you can start playing your CDs. We'll discuss three programs for playing audio-CDs.

The Windows 3.1 Media Player



The Media Player program is in the Accessories group. Double-click to see the startup screen which is fairly self-explanatory. The buttons provide the same function as those found on cassette recorders, video recorders and CD players. Notice that in addition to the Play, Pause and Stop buttons, there is also an Eject button, which works only if it is supported by your drive.

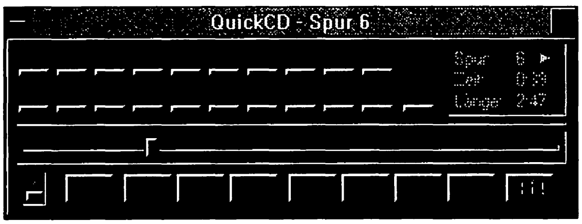
To start the CD, select **CD Audio** from the **Device** menu and press the Play button.



The Media Player

By using the **Scale** menu, you can decide whether to display play-time or titles. In any case you can move the scrollbar along the scale, either to fast-forward/rewind or to select a particular title. Although the program lacks many audio features, this also increases its universal applicability. Namely the Media Player provides a standard user-interface for all reproducible media. So you can also use it to listen to sound files, watch videos, etc.

QuickCD



The QuickCD program

Those who want more from a Windows audio program should check the software from their sound card or CD-ROM drive. In most cases an audio player will be included, sometimes also a Windows version. An example is the QuickCD included with the Sound Blaster card. By using QuickCD, you can address track numbers directly and read off the total time and elapsed time for each track.

Companion CD-ROM audio-CD players

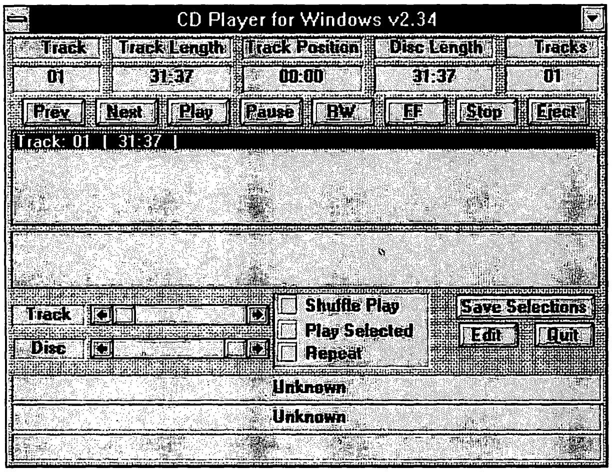
You'll also find two audio-CD players on the companion CD-ROM. Both programs are shareware, meaning that unlike their full versions, these programs have been reduced to only a few functions, which can be used and tested. If you find these programs useful, you should register them and pay the nominal shareware fee. Upon registration you will then receive the full version of the program.

CD Player for Windows

It's on the companion CD-ROM

You'll find the CD Player in the \SOUND\CDPLAY directory.

CD Player for Windows not only contains such expanded functions as Random and Repeat, you can also use it as a CD title manager. The full version of this program features a schematic oscillation curve, one that stays visible longer than just a few seconds.



The CD Player screen

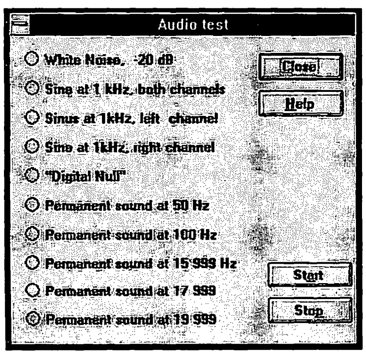
Audio testing with CDCHECK

Finally, we'll discuss the CDCHECK program which you'll find on the companion CD-ROM. It also allows you to play audio CDs.

It's on the companion CD-ROM

You'll find the CDCHECK program in the \CDCHECK directory.

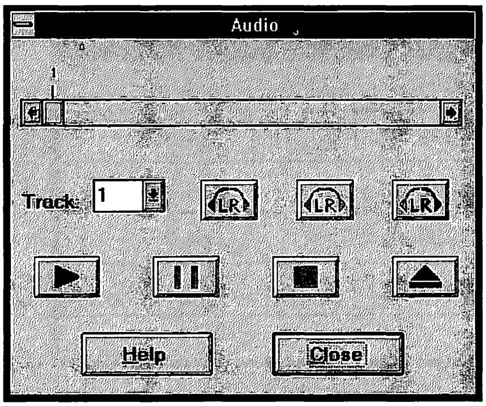
First, start the programs. Then click the **Audio** menu and the **Play CD** command.



The CDCHECK audio test

CDCHECK includes Play, Pause, Stop and Eject function buttons. You can select tracks directly through a list box or on the scrollbar. This program also includes many tests for precisely assessing your system's audio capabilities. First, the left and right channels can be selectively switched on or off by clicking the mouse.

After inserting the CD-ROM, you can use Audio Audiotest to perform additional checks. You can receive some test results simply by listening while other tests are designed to be professionally evaluated using additional instruments. Even if you're only listening, we recommend lowering the volume at the beginning of each test. This will prevent any sudden loud noise from damaging your system.



Test options

The [White Noise] button activates the "white noise" signal. This is a test signal which mixes all sound ranges. In this test signal, as in music, the middle and high ranges are somewhat diminished compared to lower frequencies. Both left and right channels are each recorded independently. This signal is therefore ideal for comparing speakers. You can also check for correct speaker phase alignment. Namely if you switch your amplifier to mono, you should be able to localize the signal exactly between the two speakers - a diffuse distribution throughout the room indicates that the speakers are properly in phase.

The next three buttons emit a steady tone at a frequency of 1 kHz. Warning: Make certain to lower volume prior to testing; these signals have been recorded at maximum volume. The 1 kHz tone originates either from both channels, the left channel or the right channel. You can use these tests to check the cables on your speakers.

Digital Null is a test which uses a very soft signal, recorded at the lowest recording limit of the CD. You should hear only minimal noise and interference throughout this test. Make certain to lower the volume after testing if necessary.

The next five tests reproduce single-frequency sounds from the audible range. They're primarily designed for use with measuring devices, but of course you can also simply listen to them. The following frequencies are available: 50 Hz, 100 Hz, 16,000 Hz, 18,000 Hz and 20,000 Hz.

The Silence test generates absolute silence for 20.06 seconds. Any noise which you might hear will be coming from your system.

CD Complete: Put It In Action

All test data is recorded on audio tracks on the CD. The first track is the data track. Tracks two through twelve are audio tracks which you can access directly with the CDCHECK program. The following table is a summary of all tests:

Track	Test	Duration in seconds	Track	Test	Duration in seconds
2	White Noise	30.09	8	100 Hz	4.03
3	1 kHz - both channels	30.01	9	15999 Hz	4.00
4	1 kHz - left channel	6.08	10	17999 Hz	4.00
5	1 kHz - right channel	6.05	11	19999 Hz	4.05
6	Digital Null	15.03	12	Silence	20.06
7	50 Hz	4.00			

Setting up your system for sound

In this section we'll explain how to use sound files. Your system must be properly configured before sound files can be used. This includes the sound files on the companion CD-ROM. Your system must include the proper driver installation, system sounds and adjusting volume with the mixer program.

The driver installation simply involves copying the driver files into the Windows and Windows System directories and then modifying the initialization files. Your SYSTEM.INI file might look like the following after installing the sound driver:

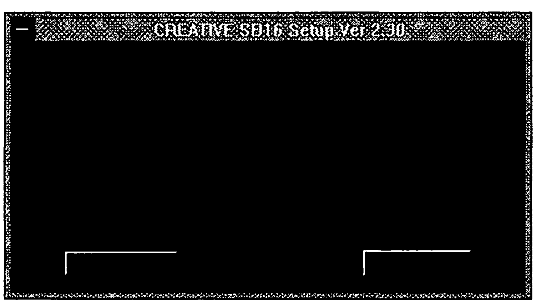
```
[mci]
Sequencer=mciseq.drv
WaveAudio=mciwave.drv 5
AVIVideo=mciavi.drv
CorelMOVE=C:\GR\CD\PROGRAMS\mcicmv40.drv
Animation1=mciaap.drv
CDAudio=mcicda.drv

[drivers]
midimapper=midimap.drv
timer=timer.drv
MIDI=sb16fm.drv
msvideo=vblaster.drv
```

```
VIDC.RT21=indeo.drv
VIDC.MSVC=msvidc.drv
AUX=sb16aux.drv
Wave=sb16snd.drv
MIDI1=sb16snd.drv
VIDC.CVID=iccvid.drv
VIDC.IV31=indeov.drv
VIDC.MRLE=MSRLE.drv
VIDC.YVU9=indeov.drv
WaveMapper=msacm.drv
MSACM.msadpcm=msadpcm.acm
MSACM.imaadpcm=imaadpcm.acm
```

The [mci] section contains all installed MCI drivers, for example, MCICDA.DRV for CD audio. The [drivers] section lists additional driver files, some of which are standard for Windows. Examples in this section include the MIDI Mapper driver MIDIMAP.DRV and the TIMER.DRV timer driver. We'll discuss the MIDI Mapper driver later. The TIMER.DRV synchronizes programs which are running simultaneously. This is also where you install additional drivers. The installation program for the Sound Blaster card has already made several entries here, each for a different function, e.g. Wave driver or AUX driver.

In case you encounter any problems and you determine the driver was installed incorrectly, we recommend that you do not make the entries directly in the initialization files. Instead, you should go through the Control Panel. Follow the same procedure as with the CD-audio driver described above. At the end of the installation, or if you explicitly click the Setup button, you will be offered several setup options for the drivers. The options vary depending on the driver. In this case we are again working with the Sound Blaster 16, specifically the configuration of the Wave- and MIDI driver. Here you can check I/O base addresses, interrupts and DMA channels. Finally, you must restart Windows whenever you install a driver for the first time or change its settings.



Configuration of a sound card

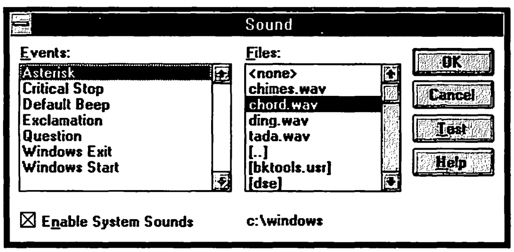
CD Complete: Put It In Action

System sounds and mixer control

The first sounds you might want to set up in Windows are the system sounds. As you may have already noticed, Windows lets you assign sounds to various system events. To view or change these settings, call up the Sounds program from the Control Panel.

The dialog box displays two listings: The possible events appear on the left and the available sounds on the right. Events include actions such as Windows Start and Windows End. If you want to change the setting for an event, select the event from the list. The list next to it will display the corresponding sound file. If you see "<none>" displayed, then the event has no system sound assigned to it.

However if you would like to hear a particular sound when Windows starts, all you need to do is select it in the list. Clicking the [Test] button lets you test the selection first. To assign sound files to other events, follow the same steps. Select the events from the list box and then select the desired sounds. When you are finished the settings will be saved when you click the [OK] button. If all system sounds are inaudible, simply check the Enable System Sounds box.



Linking sounds to Windows events

You're not limited to the standard Windows sounds when assigning sounds to events because any sound file in WAV format can be linked to an event.

You'll find a collection of 100 sound files on the companion CD-ROM in the \SOUNDS directory. You can look through the sounds and copy those you like best to the hard drive. We'll soon discuss a program which will let you search through the CD quickly.

It's on the companion CD-ROM

You'll find a collection of 100 sound files in the \SOUNDS directory.

First, however we should mention another program for setting up and configuring sound under Windows. Even if the sound card, driver and system sounds have all been installed correctly, you still may not hear any sound. A simple reason for this may be insufficient volume. You should check the volume control on the sound card, and if necessary set it to the maximum.

In addition, newer sound cards (and all MPC-compatible sound cards) feature a mixer which is a software option for adjusting volume. The mixer also lets you combine several sources together. For example, you can play a WAV file at the same time as an audio-CD. Since each sound card comes with a mixer, each mixer program is different. An icon for the mixer appears automatically in a program group after installation of the driver. This is the picture that comes with the Sound Blaster 16:

The Sound Blaster mixer

You can set overall volume with Vol and adjust the pitch in the **Controls** menu.

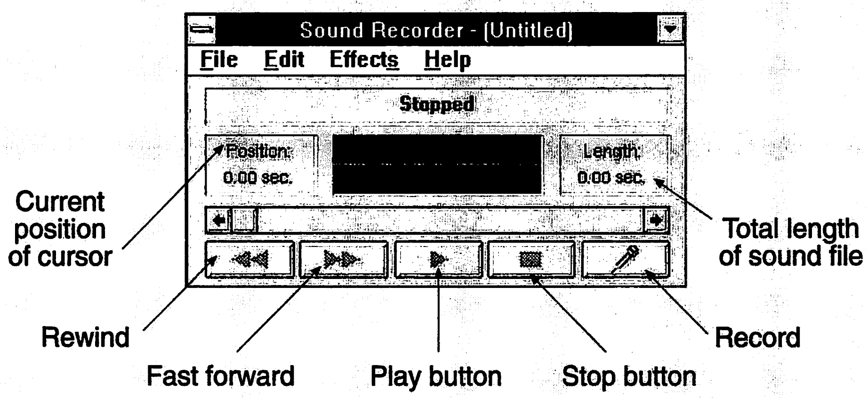
Individual channels can be adjusted with the arrows. The VOC control is responsible for sound files in WAV format. At a VOC setting of 0, you cannot hear any WAV files even at maximum overall volume. Similar controls also exist for MIDI, CD-audio, LINE-IN, microphone and speaker.

The Sound Recorder

Similar in principle to the Media Player is the Windows Sound Recorder. While the Media Player exists purely for reproduction of such varied media as CD-audio and sound-, MIDI- and video files, the Sound Recorder only records and edits Wave files.

Like the Media Player, the Sound Recorder offers a rather limited number of functions, which is greatly surpassed by some of the recorder programs available with sound cards. Even so, because of its universal applicability, we will discuss the Sound Recorder in some detail.

The program is located in the Accessories group. Upon starting the Sound Recorder you will see the usual media buttons familiar from other programs and devices.



The Windows Sound Recorder

There are at least three possible uses for the Sound Recorder:

1. Listening to existing WAV files.
2. Recording (sampling) WAV files from various sources connected to the LINE-IN jack such as microphones, CD-audio or stereo systems.
3. Editing the sound files.

All functions of the Sound Recorder have one restriction however - the maximum length of each sound file is 60 seconds.

You'll use the commands in the **File** menu to load and save files. To load a file, select **File/Open**. The name of the sound file will appear in the title bar of the program window when it's loaded. Sound reproduction now becomes virtually self-explanatory - the Play button plays the file. The current position within the file appears to the left of the digitized sound wave as the file plays. The total file length appears to the right digitized sound wave.

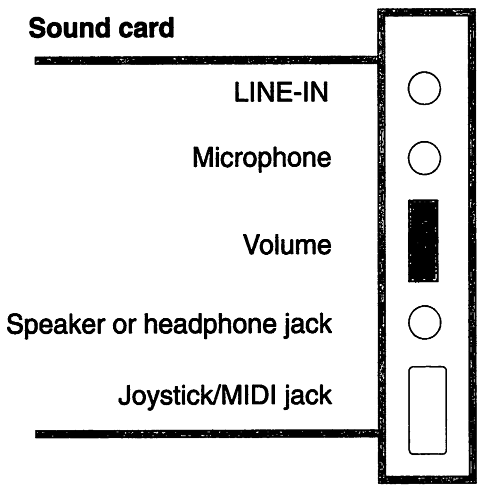
The Fast Forward and Rewind buttons take you directly to the end or the beginning of the sound file. Use the scrollbar to access any location between the beginning or end of the sound file.

Saving the file is similar to saving files in other Windows applications. However, you should always include the .WAV file extension because the Sound Recorder doesn't add the file extension automatically.

Microphone recording

The main task, however, of the Sound Recorder is recording WAV files. Before you can change sound sources or adjust volume, you'll also need the mixer program. A mixer is not normally included with Windows and since it comes with the sound card it will vary from system to system.

The first step in recording with the microphone is connecting the rear jack with the sound card. Make certain the microphone is plugged in correctly. In addition, the volume control on the sound card must be set on or close to the maximum. The mixer program then assumes the task of volume reduction through software.



Options for connecting a sound card

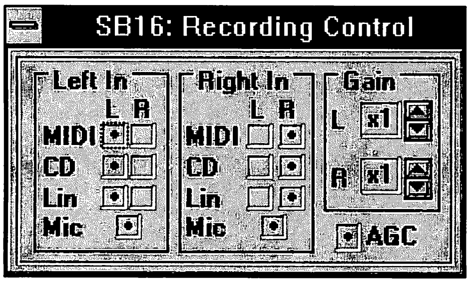
The mixer is also responsible for selecting the recording source and adjusting its input signal. The sound source for the microphone is normally set so you can immediately begin recording. Take the microphone and click the Record button (the button with the microphone) in the Sound Recorder. Recording ends when you click the Stop button (the button with the square).

During recording you will see a schematic representation of the sound waves in an "oscilloscope" window. A wave form whose highest points reach just below the representable range indicates a correct recording level. If you do not see any waves, either nothing was recorded or what was recorded was so soft the Sound Recorder could not detect it. If the upper wave range is cut off, then the recording was overmodulated or too loud. You can always check the results of your recording by pressing the Play button.

Overmodulated recording

To correct an overmodulated recording, you can either lengthen the distance between source and microphone (normally the better alternative) or adjust the input volume with the mixer. The mixer program will have an arrow control for the microphone, usually labelled MIC. You can prevent overmodulation by reducing the volume or improve recordings made too low by raising the volume.

The mixer is also used when you change the recording medium, for example to an audio-CD in the CD-ROM drive. Here you can set the sound source to be used by the Sound Recorder. The SB-16 mixer program (of the sound card) provides an extra recording control window, which you can activate through the **Settings** menu.



Recording control

First, you can activate a preamplification by using the Gain buttons. Each channel can be preamplified by a factor of 2, 4 or 8. Automatic gain control (AGC) automatically adjusts the degree of preamplification to the recording volume.

To the left of the Gain setting you can define separate input sources for the left and right recording channels:

MIDI accesses MIDI data, originating either from an external device or from the internal MIDI-interface. The external source could be an attached MIDI device, while the internal one could be the Media Player currently playing a MIDI sequence.

CD uses sound signals from an inserted audio-CD that has just been played. Warning - this applies only to CD-ROMs connected internally to the sound card via audio cable.

LIN (LINE-IN) uses input signals from the LINE-IN jack. Possible attachments can be a stereo system or also the built-in CD-ROM drive. Assuming no internal connection exists between the sound card and the CD-ROM drive, and you have therefore connected the CD-ROM drive to the sound card (actually the LINE-IN jack) either through the front headphone jack or the jack on the controller card, then sound recordings from the CD player will proceed through the LINE-IN input and must be declared as such in the mixer program.

The last option is the standard microphone setting. In addition you can also combine several sources together, by clicking them sequentially. With the Sound Recorder, however, the recording limit is still 60 seconds. For longer recordings you must switch to another program.

Editing sound files

You not only can play and record sound files using the Sound Recorder, but you can edit and manipulate sound files too. The last action performed can be reversed at any time with the **Restore** command from the **File** menu.

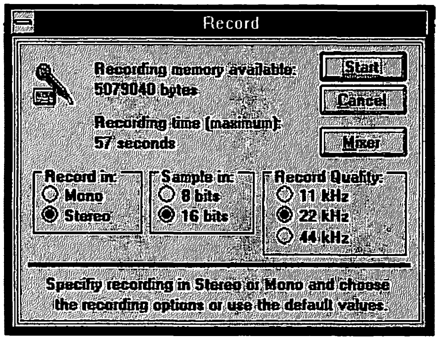
In the **Edit** menu you will find the **Erase Before Current Position** and **Erase After Current Position** commands . You can use these to eliminate pauses at the beginning or end of a file. For example, if the first second of your file is silent, with the scrollbar place the cursor at 1.00 seconds and call **Erase Before Current Position**. The first second then disappears. Unfortunately the Sound Recorder is unable to select time ranges in the middle of a file.

Also, in the **Edit** menu, you will find the **Insert File** and **Mix File** commands. The **Insert** command lets you insert a sound file at the cursor position. For example if you wish to insert a third word between two spoken words, move the cursor to the pause in between (recognizable by a break in wave output) and insert the file. File mixing produces very interesting effects, since at the point of insertion the contents of the mixed file is superimposed on the original sound. You can use this option for example to provide a musical background for the spoken voice.

Finally, the **Edit** menu also contains the **Copy** command which lets you transfer the entire file as an object to the Clipboard. No menu entry exists for the opposite direction however, i.e. retrieving data out of the Clipboard. For this case you must use the old key combination Shift+Ins.

The **Effects** menu offers various methods for altering sound file data. Not only can you raise or lower the overall volume of a file, you can also reverse the entire piece, add an echo or with the **Speed Up** command, produce a "Donald Duck"-like effect.

Other recorder programs offer substantially more functions than the Sound Recorder. For one thing they allow you to adjust the sampling rate and resolution for the recording. The Sound Recorder has a fixed sampling rate of 11.025 kHz and a fixed resolution of 8 bits.



WaveStudio

WaveStudio, the recorder program for the Sound Blaster card, has adjustable settings for mono/stereo, sampling rate and resolution.

Normally, sound card programs are preferable to the Sound Recorder because of their more extensive editing capabilities.

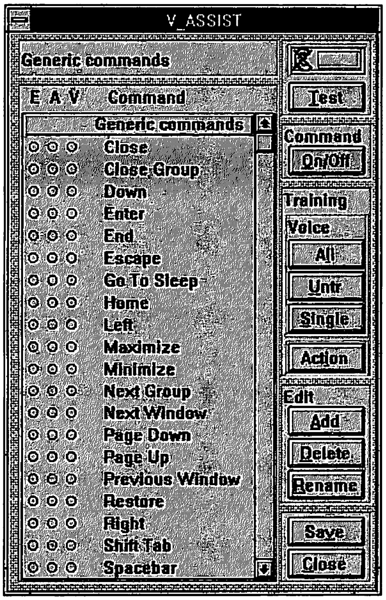
The PC listens to commands

To end this section we will present a program which, although it also performs sound recording (in this case via microphone), takes the sound program concept to an entirely new level. Commands can be entered not only through the keyboard and mouse - now you can give orders to your PC over the microphone.

The Advanced Signal Processor (ASP) of the Sound Blaster 16 makes this possible. A special program called VoiceAssist converts spoken commands to program commands. Of course VoiceAssist must first be set up and configured - to do this there are predefined command set files with male and female voices.

Now if your computer cannot interpret your voice correctly based on the standard files - as usually happens in practice - you can train the machine by speaking sample commands into the microphone. Technically, the analog input signal is sampled and stored.

Then when an acoustical input is received it is compared with the stored tables, based partially on learned commands and partially on the standard ones. Upon finding a match the command is executed. In addition to the predefined commands, you can also define command sequences yourself (i.e., macros), and then enter them as spoken commands.



VoiceAssist

VoiceAssist lets you edit acoustic WinWord commands.

In practice this program is not yet 100% usable. Given our current state of technology, its success rate is perhaps 75%. In all other cases either nothing happens or a completely different command is carried out. At most, this technology is useful only in very narrow contexts. This type of PC sound application is nevertheless the wave of the future.

Sound in MIDI format ?

MIDI (Musical Instrument Digital Interface) is a standard developed in 1983 for the music world. This standard made it possible for individual musicians to generate and edit sound sequences from different instruments before combining them into one "orchestral" piece.

MIDI refers to both a hardware interface between various MIDI-compatible devices to a (partially) standardized file format through which these devices can exchange information.

The PC is considered a MIDI-compatible device when it has a MIDI-compatible sound card. The MIDI feature is common on the newer sound cards especially since it's required by the MPC standard. The next question is what can this MIDI technology do for the PC user? A look at the technical specifications for newer sound cards, listed in the preceding section, should provide a clue. Sound cards contain

synthesizers, which are used to generate artificial sounds. How then are these synthesizers controlled? One way is through MIDI files. If your sound card contains an internal MIDI-interface the synthesizer can accept and process MIDI data.

Not only is it possible to play MIDI files on a PC, but with an external hookup you can also send PC data to MIDI devices. That is, a MIDI file is generated and stored in the PC, and is sent to a device such as a keyboard using the MIDI-interface. The second device then reproduces it as a piece of music.

The opposite is also possible - you can play a musical piece on the keyboard and then transmit it using the MIDI-interface to the PC. There you can play it immediately through the sound card or save it as a MIDI file.

Sequencer programs

To put these possibilities into action, you must also have the appropriate software in addition to the sound card and its driver. One type of program is central to the MIDI-interface - the sequencer. In its most basic form, a sequencer is a program that reproduces MIDI files. In most cases you can also use it to generate, edit and store MIDI files. MIDI files can be recorded either manually through entries on the PC keyboard or by a MIDI device as it plays a musical selection.

There are two types of sequencers:

1. Single-step sequencers are notation programs which generate MIDI data from various parameter entries such as pitch, instrument, etc.

2. Real-time sequencers let you keep the MIDI data, recorded perhaps by a keyboard using the MIDI-interface, fixed in real-time.

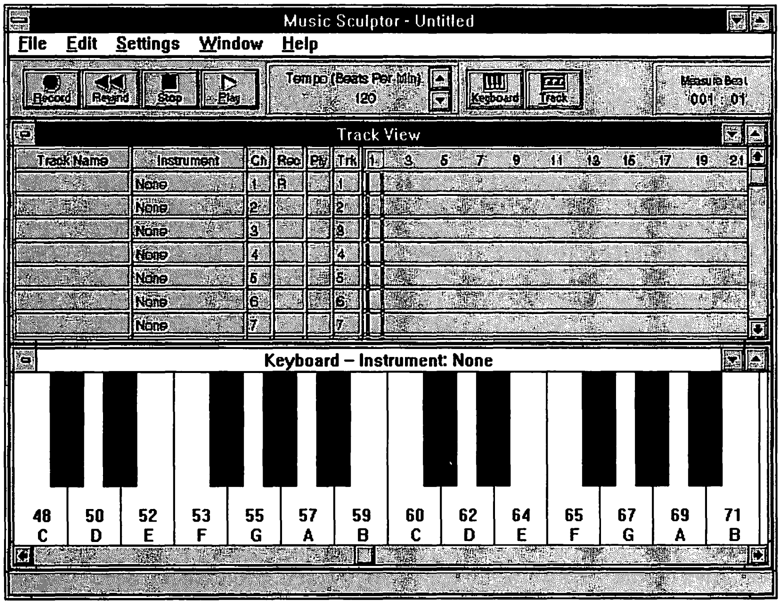
Some sequencers integrate these two functions. You can record notes in real-time and edit them as well.

The directory \SOUND\WMSCULP on the companion CD-ROM contains a shareware MIDI sequencer called Music Sculptor.

It's on the companion CD-ROM

You'll find Music Sculptor in the \SOUND\WMSCULP directory.

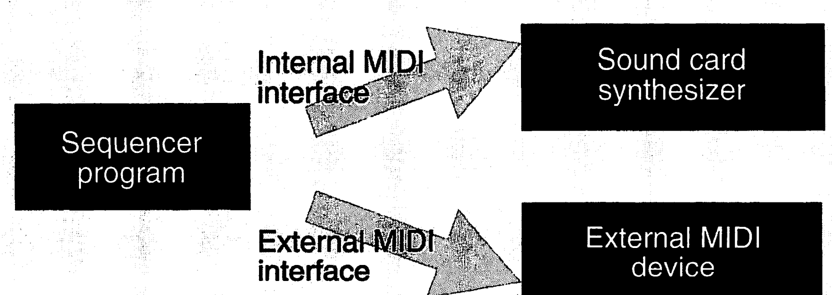
By using this program you can not only play MIDI-sequences but also record them yourself. Potential sources include keyboards attached to the external MIDI-interface and notes entered on the PC keyboard. MIDI-sequences, including standard MIDI-songs which you load into the system, can to a large extent be changed and edited. As a supplement to Music Sculptor the program directory also includes several freeware MIDI files.



The Music Sculptor program

Please note the Music Sculptor program is shareware. If you continue to use the Music Sculptor program, you should register it according to the information in the Help function.

Reproduction of MIDI files always occurs through a synthesizer. This can be either the internal sound card synthesizer or the synthesizer of an attached MIDI keyboard.



MIDI data

With MIDI you can simultaneously control an entire string of output devices with one sequencer. The sequencer was not originally intended as a PC program but instead was designed as a component of MIDI-compatible keyboards. Thus MIDI was primarily of interest to musicians working with electronic sounds.

MIDI guarantees a smooth transfer of data from original sound source to peripheral MIDI device. These devices do not necessarily have to be musical instruments - a whole series of MIDI-compatible devices exists, for example lighting devices.

MIDI files have this flexibility because they do not contain acoustical signals or digital values for specific notes as is the case with WAV files. Instead, they contain commands for generating sounds. In addition to basic values such as pitch and duration, there are file entries for the instrument to be used, sound pattern, beat, etc. For example, the **Note On** command represents the pressing of a key on a keyboard and **Note Off** its release.

The result of this data representation scheme is that MIDI files are much more compact than WAV files. MIDI files can vary considerably in size, even with equal lengths of music. A three-minute MIDI file, however, might occupy 60K of space, while a WAV file of equal length would require at least 3 Meg of space (depending on the resolution).

The MIDI standard

The MIDI standard comprises a total of 16 channels numbered 1 to 16. Each channel can be assigned an "instrument." Each channel can also send or receive. MIDI data therefore includes, among other parameters, the channel number and the selected instrument.

All manufacturers support the same 16 channels but not the same assignment of instrument numbers. So, a particular MIDI file will sound different on systems with different instrument assignments. Under Windows however you can change these assignments by using the MIDI Mapper. Microsoft has developed a standard for instrument assignments, which in most cases should correspond to the external MIDI devices. Otherwise, you would use the MIDI Mapper. The procedure for this, as well as the practical implementation of MIDI under Windows, will be discussed shortly. First however a brief excursion into the world of musicians.

What is General MIDI?

MIDI-transmitted impulses were originally so specific to individual manufacturers that only rarely did a device exist which was also compatible with products from another company. The manufacturers soon realized that separate standards were doing more harm than good to both the music industry as a whole and to themselves. Therefore, the MIDI values, which are still not universally accepted, were again restandardized. The result was called General MIDI. The frustrated MIDI user finally has guaranteed compatibility of all MIDI components providing elements in the system carry the General MIDI label.

MIDI setups

With MIDI you can connect all kinds of instruments and peripherals to your system (called a setup). The attached devices are normally accessed through a central control unit called a *master*. The master function is usually assumed by a "master keyboard" which like the PC keyboard, can be considered an input device. The MIDI-interface serves as a transmission line for musical as well as non-musical data on their way to peripheral devices. MIDI basically meets this task by transmitting control commands and memory contents.

Possible MIDI applications include the following:

- Addressing several output devices with one input keyboard to create a mixed multiple sound effect.
- Synchronizing a drum computer or sequencer program.
- Transmitting sound parameters, such as effects, to other devices.
- Combining a variety of MIDI input devices (MIDI-compatible guitar, saxophone, drums etc.).

Three types of connections are required:

- MIDI-IN connection to receive data
- MIDI-OUT to connection send data
- MIDI-THRU transmits data received by one device to other devices

Within the MIDI cable, information transfer proceeds (as the names indicate) in one direction only. If two devices are set for two-way communication, you'll need two cable connections with each MIDI-OUT jack connected to the MIDI-IN jack of the other device. To avoid synchronization or transmission errors, the MIDI standard allows a maximum length of 15 m for all MIDI cables. The connectors are the usual five-pin DIN jacks. Although manufacturers often sell ordinary stereo cable as MIDI cable, these stereo cables have little to do with MIDI. Therefore, you should look for properly-shielded cable designed specifically for use with MIDI. This also helps ensure the highest quality.

Since MIDI is a serial interface, all information is transmitted bit by bit. The transmission rate is approximately 32,000 baud. This relatively slow rate can limit connections between multiple MIDI devices. Technically, there are 128 possible values for channel control variables, given the normal 7-bit resolution. At the same time this means that a MIDI-controlled sound module can process a maximum of 128 halftone parameters.

CD Complete: Put It In Action

A MIDI setup is a strictly hierarchical assembly of MIDI-compatible devices. As we said before, the central control function is carried out by a master, generally a master keyboard or synthesizer. From here, control-impulses travel through MIDI channels to the attached slaves, the peripheral devices. An example of a simple MIDI system consists of two keyboards. Music is played on the keyboard defined as the master, which then transmits the impulses to the secondary slave keyboard. The point of this for example is to play a solo sound on the master, and simultaneously play the orchestral accompaniment on the slave.

All this occurs via one keyboard, the master keyboard. At the same time it also means that in this case, the keys of the slave keyboard are not needed at all. The music industry has long since taken this into account. In addition to their fully-functional master keyboards (with keys), manufacturers now offer, often in the same package, pared-down slave versions (without keys). These slave keyboards are bought by the dozen by true music fanatics - with them come the latest technology and the latest sounds.

Data transmission modes

As we mentioned, MIDI data can be split into sixteen channels. Various modes are available for slaves connected to a master keyboard to determine which signals are extracted from the data stream and how they are processed.

Omni mode

In Omni mode all incoming data from the slave is accepted and processed. This occurs regardless of the channel number used. The Omni mode however is not recommended the moment you connect more than one slave to your system. The whole point of the MIDI channel setup is to be able to control several devices independently. This cannot be guaranteed in Omni mode.

Poly mode

A device operating in Poly mode normally uses MIDI data exclusively from a freely selectable channel.. The slave ignores all information from other channels. The term "Poly" is not contradictory, it means that since just one channel is responsible for each slave, you can integrate up to sixteen different slave-components into the MIDI system.

Mono mode

Mono is recommended for initiating several (up to sixteen) different sounds through their respective MIDI channels (polyphony). Of course, both components, the master and the slave, must be equipped for Mono mode. This is usually the case with the newer devices.

What is MIDI data made of ?

Basically MIDI data falls into the following three groups:

- Channel messages
- System common messages
- Exclusive messages

The commands and messages are transmitted in lengths of up to three bytes, depending on the size of the required MIDI command. The first byte is always a status byte. It identifies the channel number for example and sends specific commands relative to that channel. The other bytes consist exclusively of descriptive characters. They're used only as data bytes and then only if necessary.

Channel messages

Channel messages take notes played on the master keyboard and transmit them directly to peripherals as commands. The messages include not only the note's pitch and duration, but also the number of simultaneously played keys, the tempo (velocity) and various sound characteristics such as intensity of keystroke (aftertouch), sound modulation through a pitch wheel, pedal-effects and more. To play the note on the slave as well, the MIDI transmission must contain a Note On command. The note is then held until an explicit Note Off is recognized. At times this process can result in a "hanging" note, perhaps due to a weak spot in the cable. The slave either cannot recognize the Note Off or the command fails to arrive at its destination, and so the note is never switched off in the slave's sound module. For such cases MIDI also provides a panic function. Options include a complete system-reset, which resets all devices in the MIDI system, or an exit/panic order (All Notes Off), which works on a specific channel and resets one slave only.

MIDI is capable of transmitting several parameters in real-time mode. In addition to the qualitative data, it also transmits frame instructions. The frame instructions usually must be entered at the master keyboard. This applies, for example, to the Program Change instruction. It tells the sound module in the slave to play the upcoming notes with a completely different sound configuration. As we mentioned, a maximum of 128 (sound) program memory locations are available for selection. The corresponding program-memory commands are directly relayed to the receiver's sound module as a data byte, which is simply appended to the status byte being transmitted.

Channel messages also include information about the impact dynamics and volume of the depressed keys. The instructions are executed as Control Change messages, which can represent up to 32 different internal controllers and switches. General operating parameters also fall within this category. The command **Local Off**, for example, lets you separate the piano keyboard from a synthesizer's internal sound module; the sounds can then only be retrieved through MIDI.

System common messages

System common messages are more powerful than channel messages. They affect all devices in the MIDI setup and consist of such general instructions as automatic voice equalization of all oscillators, and exit and reset commands. If no data is being sent from this group, MIDI transmits a continuous control signal on this track to the peripheral modules (active sensing). If at some point no signal input is recognized, a complete reset occurs at the device in question. In this case, the slave pauses and the music must continue playing somewhere else.

The MIDI system real-time clock is essential to this process. To achieve maximum synchronization of all notes in the slave modules, the master emits a timing-clock signal 24 times per quarter-minute, thereby constructing a very fine time-slot grid with which the peripheral devices can align themselves. Also related to the timing mode is the MIDI-specific song position pointer, which continuously informs all slaves of the current clock position within a song. Automatic rhythm machines for example work closely with this message.

Exclusive messages

Because exclusive messages are reserved for internal setup instructions specific to a particular manufacturer, they're normally not recognized by products from different manufacturers. Some programs however, such as editors, take advantage of this by retrieving the parameters from the sound module through the Sysex function and displaying them on the editing screen.

Technical specifications for MIDI

1. Channel voice messages:

↳ Information about the number of depressed keys, their pitch, intensity and related effects (aftertouch, pitch wheel etc.).

2. System events:

↳ Data for synchronization of all channels (real-time messages) affects such things as current clock rate, rhythm and overall pitch.

3. Mode messages:

   Options include:

- Omni mode, where sending and receiving occurs on all 16 channels, as well as
- Poly mode, in which a specific channel is assigned to each device and
- Mono mode, in which a device generates different sounds depending on the number of channels in use

4. Exclusive messages:

- Data exclusive to a particular manufacturer, or preset
- Data conversion factors for a particular device, relating to sound formation, for example.

5. Reset commands:

- Automatically restore system components to their original state; also
- Panic function (All Notes Off!).

MIDI Commands

1. Channel messages	
All Notes Off	Switch off all current note settings
Control Change	Change a controller or switch
Local On	Establish connection (master and slave)
Local Off	Disconnect
Mono Mode On	Mono mode, only one part is played
Mono Mode Off	Switch off mono mode, produce polyphonic sound
Note On	Play note
Note Off	Stop note
Omni Mode On	Set all channels to receive
Omni Mode Off	Switch off receive on all channels

1. Channel messages (continued)	
Pitch Wheel Change	Change on pitch wheel
Pressure	Aftertouch Keystroke with aftertouch
Program Change	Change sound program
Reset All Controllers	Restart all controllers and switches

2. System messages:	
Activate Sensing	Check control signal
Continue	Instructs sequencer to continue playing
Eox	Ending for exclusive messages
Reset	Reset all components
Song Position Pointer	Indicates clock position relative to start
Song Select	Selects song at sequencer
Start	Starts sequencer
Stop	Stops sequencer
System Exclusive Message	Data for a specific sound module
Timing Clock	
Tune Request	

MIDI-compatible devices

Keyboards

- With keys, for input and reproduction of musical data via MIDI
- Without master attributes

Master keyboards

- With keys, for data input and control of peripheral devices
- Without own sound-generating capability, with preset or entered sounds
- Multiple MIDI control options

Synthesizers

- With keys, for data input and control of peripheral devices
- Own sound generation with multiple sound options

Expanders (synthesizer/keyboards without keys)

- Integrated into MIDI system sound module, can only be used as slave
- Are activated by a master or synthesizer

Rhythm machines

- Drum sets with MIDI-converter, providing own resonance
- Drum pads with electronic sensing, without own resonance

Additional MIDI-compatible musical devices

- Organs, pianos (digital pianos), all processor-controlled
- Wind instruments with MIDI-converter as scanner and compiler
- Guitars and other string instruments

Samplers

- Enable digital recording of acoustical sounds/noises in MIDI format

Effect generators

- Enable stereophonic effects (concert hall etc.)
- Sound alteration (e.g. distortion, stretching)

Mixers

- To coordinate coexisting musical devices
- Also possible in PC

Digital recording devices for musical pieces

- Sequencer in keyboard
- Sequencer software for PC
- DAT recorder

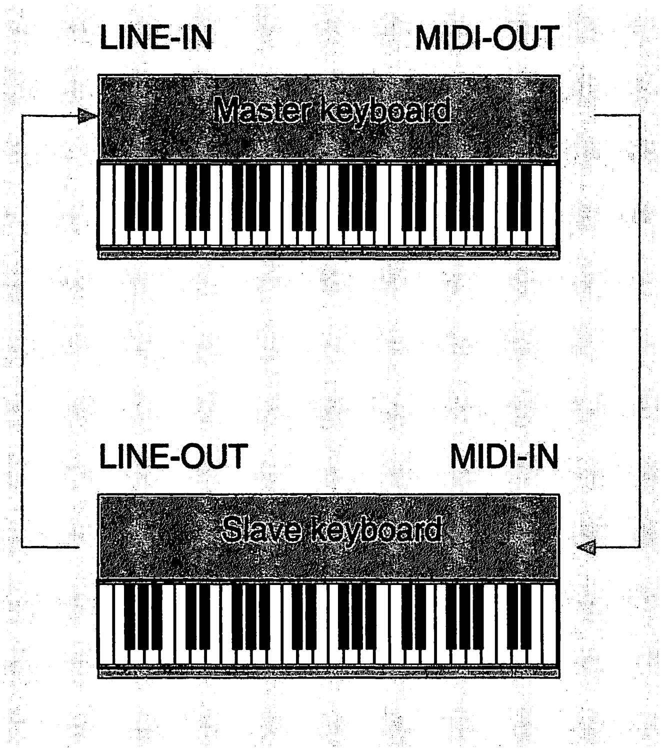
Computer software

- Note input via screen
- Note input via MIDI
- Play through sound card or MIDI

MIDI setup examples

1. Two keyboards (one master and one slave, hierarchically ordered):

In this rather simple MIDI system, the main issue is which keyboard has the better set of keys and which one has the better amplification/loudspeaker system. The device with the better keys would always be used as the master. The sounds do not necessarily have to be amplified and reproduced on the master however. You can assign this task to the slave, if it has the better equipment. The only crucial thing here is having the proper cable connections. The master (active musical device) takes the sounds input by the musician, piano notes for instance, and transmits them to the slave. The slave's sound module then generates, virtually simultaneously with the master data, a second sound such as strings. Through the LINE-OUT jack, the slave then sends this self-generated sound as a true musical signal back to the master, where the sounds of both keyboards are amplified together and reproduced on the loudspeakers of the master keyboard.

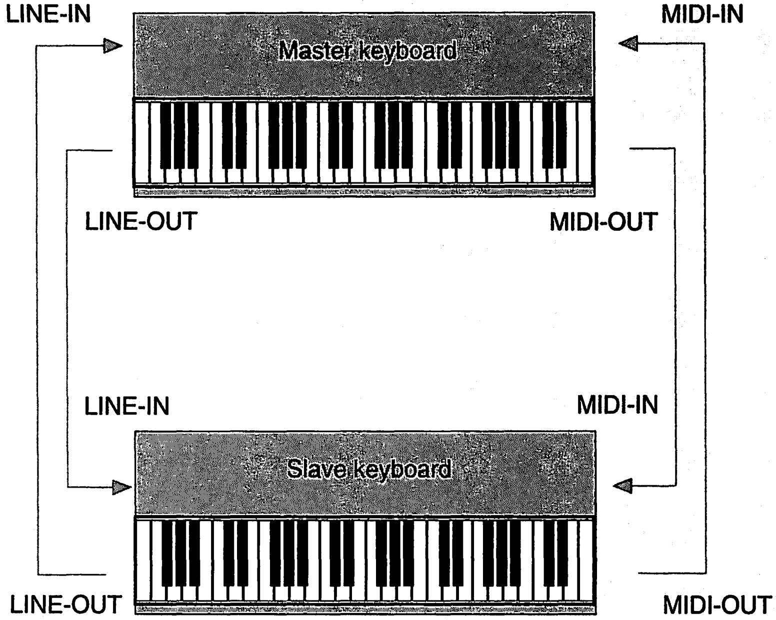


Master and slave keyboard

Through MIDI-OUT the master data is given to the slave keyboard. The sound produced there travels as "real" music from the LINE-OUT jack on the slave back to the amplifier and speaker output on the master keyboard. The sounds of both devices have thus been mixed together and are reproduced as audible music through the loudspeakers attached to the master keyboard.

2. Two keyboards (one master and one slave, working in parallel):

In this setup the master and slave are connected virtually in parallel. The sounds are generated just as in the previous example, except that the sounds produced in each sound module are reproduced together, in the amplifiers of both keyboards. The master-slave relationship holds only to the extent that keyboard and signal input occur on the master keyboard. The slave, however, amplifies the input and reproduces it.

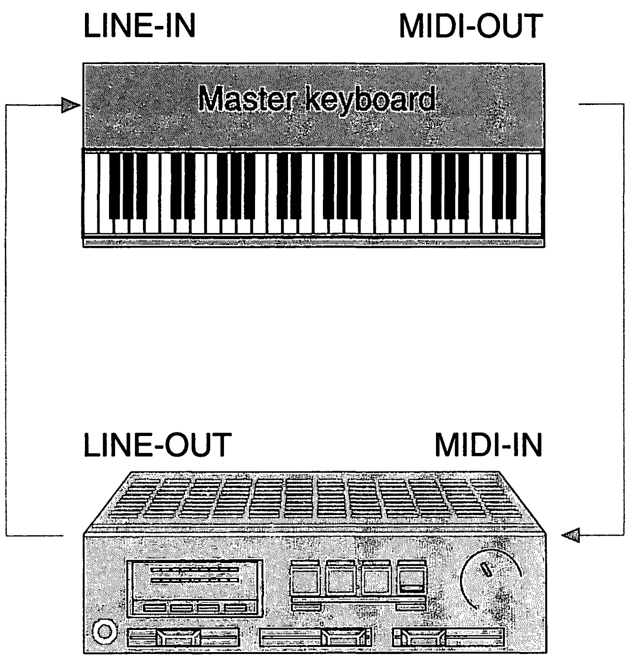


The parallel variation

The illustration shows how, in contrast with the preceding example, the individual devices are connected so they will simultaneously reproduce sounds from both keyboards through both speaker systems.

3. One master keyboard and one genuine slave (e.g. expander):

The MIDI system makes it possible to control multiple keyboards with a single set of keys. So why not make these devices without keys in the first place? Such MIDI modules are known as expanders - their numbers in the meantime have mushroomed, with no end yet in sight. Also missing from these devices, in addition to the keyboard, is the amplifier and along with it the loudspeakers. In this case the slave really is just a mute servant, which by itself is capable of very little. Only in conjunction with a master keyboard does it become a useful instrument. As in the first example the connections are quite simple. With the elimination of expensive keyboard mechanisms and amplifiers, expanders are much less costly yet provide you with the latest in processor technology.



A peripheral device as a slave keyboard

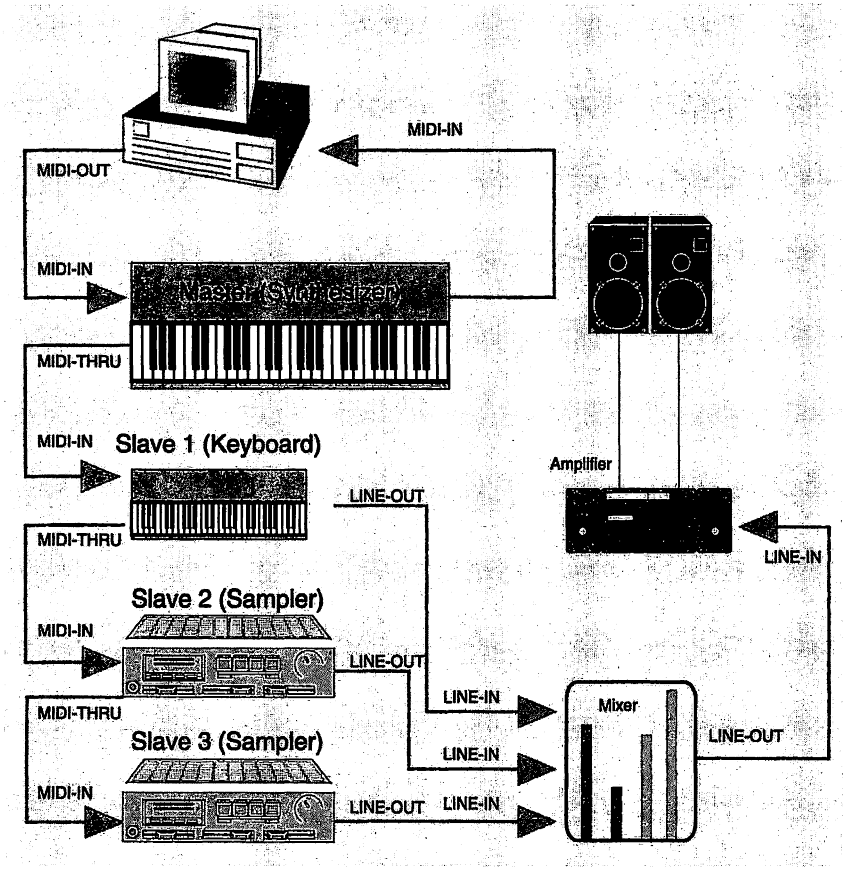
Expander modules as peripheral devices are relatively inexpensive and can be set up as slave keyboards. Through MIDI only the sound-producing processor is accessed in the slave; final processing of the returned sounds usually occurs within the master keyboard.

4. Larger MIDI systems in practice:

According to the MIDI standard, MIDI can control up to sixteen different devices at the same time. Let's see two ways to connect a larger number of peripheral devices.

In a series connection, individual slave components respond to only those MIDI signals set to the same channel as they are. All other data travels unchanged via the MIDI-THRU switch directly to subsequent devices. Note that with this method, no more than three peripheral devices should be hooked up to the master. Due to the combined cable length required to reach the last slave, a synchronous flow could no longer be guaranteed after this point. We also recommend routing each component's signal output parallel to a mixer/sequencer, so the entire sound is individually mixed before finally being sent to the amplifier.

MIDI and PC



The purpose of multiple connections is to be able to create a variety of sounds with a single keystroke. Sounds produced in this way have a very rich quality. The example also shows the required connections between PC and MIDI system. Of course, how the keyboards and slaves are arranged is up to you.

As an alternative you can create a star connection, which requires a MIDI junction box, also known as a MIDI-THRU box. This way, from the MIDI-OUT on the master you can create, in a certain sense, multiple MIDI-OUTs. Still, all data sent from the master arises from one single interface. One advantage of this type of connection is that now you can integrate more than just three devices. Furthermore, cable lengths to individual modules are significantly shorter, which produces a higher degree of synchronization.

Program locations specified by General MIDI			
001 - 008	Piano	065 - 072	Reed
009 - 016	Chromatic percussion	073 - 080	Pipe
017 - 024	Organ	081 - 088	Synthesizer lead
025 - 032	Guitar	089 - 096	Synthesizer pad
033 - 040	Bass	097 - 104	Synthesizer effect
041 - 048	Strings	105 - 112	Ethnic
049 - 056	Ensemble	113 - 120	Percussive
057 - 064	Brass	121 - 128	Sound effects

MIDI under Windows

Included with Windows is a very basic sequencer called the Media Player. With it you can reproduce MIDI data but you cannot change it. Advanced sequencer programs, such as Midisoft Studio, offer graphic note display and -editing options.

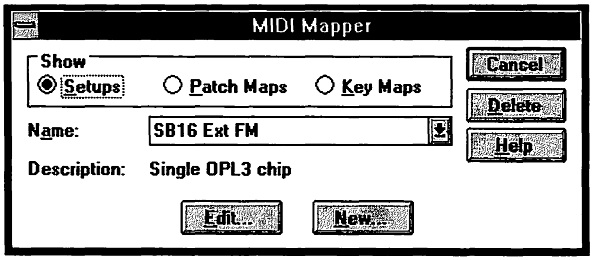
When connecting external MIDI devices to the sound card, you will see that the MIDI jack on the sound card is different from those on the actual MIDI devices. The MIDI device has a five-pin DIN connector while the sound card has a 15-pin combined MIDI-joystick Sub-D jack. Here you need a MIDI adapter, which is sold as an accessory for the sound card. One side of the adapter plugs into the sound card; the other side is a standard MIDI connector.

The MIDI Mapper

To use MIDI under Windows, Microsoft has developed a series of assignment tables, for example to assign numbers to instruments. As a rule, these assignments have been made so you can play MIDI files without having to change any of the settings. For example, say you're using the Media Player as a sequencer, which then outputs the data to a synthesizer (either an external one or the internal sound card synthesizer). In this case the program must access the tables. If you are using only MIDI files conforming to the Microsoft MIDI standard, no access is necessary. On the other hand, if you have an external synthesizer which uses Instrument Number 40 to generate a clarinet sound, whereas under Windows Instrument Number 71 is normally a violin, the tables become indispensable. A piece of music where all the clarinet parts have been replaced by a violin would sound very different indeed.

To make changes to the tables, call the MIDI Mapper from the Control Panel. There you will find two settings that you can change:

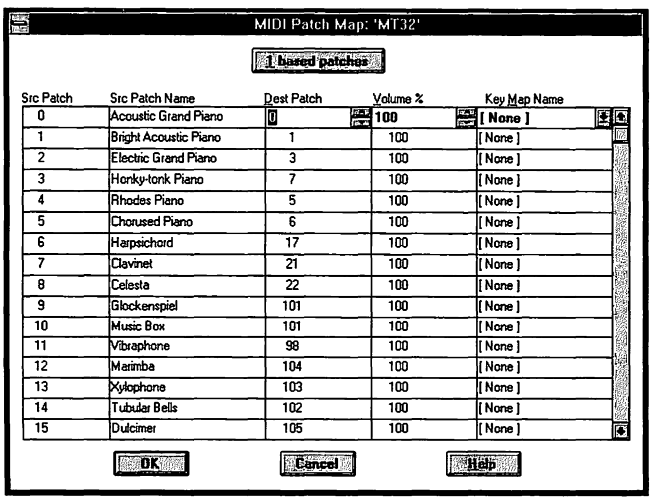
1. Under Setups you can change channel number assignments
2. Under Key Maps you can change key assignments for rhythm instruments.
3. Under the Patch Maps display, you can set the number assignments for instruments.



MIDI Mapper

In our case we need the Patch Maps display. By the way, any changes you make to the tables will be stored in the file MIDIMAP.CFG. Most sound card installation routines copy a modified MIDIMAP.CFG file into the Windows directory. Within the framework of this file, you can now select among different tables.

Edit allows you to edit the current table. New creates a new table with the original values. In this example we should click New to provide an extra table for the special device. Next, change the DestPatch value for the clarinet to the value assigned to the clarinet in the synthesizer.


MIDI Patch Map: 'MT32'

1 based patches

Src Patch	Src Patch Name	Dest Patch	Volume %	Key Map Name
0	Acoustic Grand Piano	0	100	[None]
1	Bright Acoustic Piano	1	100	[None]
2	Electric Grand Piano	3	100	[None]
3	Honky-tonk Piano	7	100	[None]
4	Rhodes Piano	5	100	[None]
5	Chorused Piano	6	100	[None]
6	Harpsichord	17	100	[None]
7	Clavinet	21	100	[None]
8	Celesta	22	100	[None]
9	Glockenspiel	101	100	[None]
10	Music Box	101	100	[None]
11	Vibraphone	98	100	[None]
12	Marimba	104	100	[None]
13	Xylophone	103	100	[None]
14	Tubular Bells	102	100	[None]
15	Dulcimer	105	100	[None]

OK Cancel Help

MIDI Patch Map

Chapter 3

CD Complete: Put It In Action

Kodak Photo-CD

The Photo-CD was introduced by Kodak in 1992. Although designed originally for the consumer market, the Photo-CD's greatest success has been with the PC. The percentage of all CD-players connected to TV sets (for viewing Photo-CDs) is actually quite small. Kodak's breakthrough in the PC world, however, has caused many new formats to emerge.

Photo-CD formats

To help you understand the many Photo-CD formats, we've summarized each format in the following pages.

Masterdisk

This is generally accepted as the standard Photo-CD format. Each 35mm photo stored in this format has a maximum resolution of 2,048 x 3,072 pixels. However, for each picture there are five different resolutions stored. The two lower resolutions and the middle resolution, which is the one normally displayed on monitors and televisions, do not involve data compression. This allows rapid construction of the image on the screen. Only the two highest resolutions permit data compression.

Here is a summary of each resolution:

Base/16

This low resolution is used to create the index print or contact print.

Base/4

These low resolutions are used in preview functions, e.g. when checking photos on the TV screen.

Base

Base is the standard display format for television and computer monitors. This format is also suitable for print output (300 dpi).

4 Base

4 Base increases the normal resolution by a factor of four. You can use this for screen display on very high-resolution monitors, or for high-resolution printing (600 dpi and up). The image data for the Photo-CD is stored in compressed form.

16 Base

This highest resolution, also compressed, is close to photographic quality and is used in DTP (Desktop Publishing) applications.

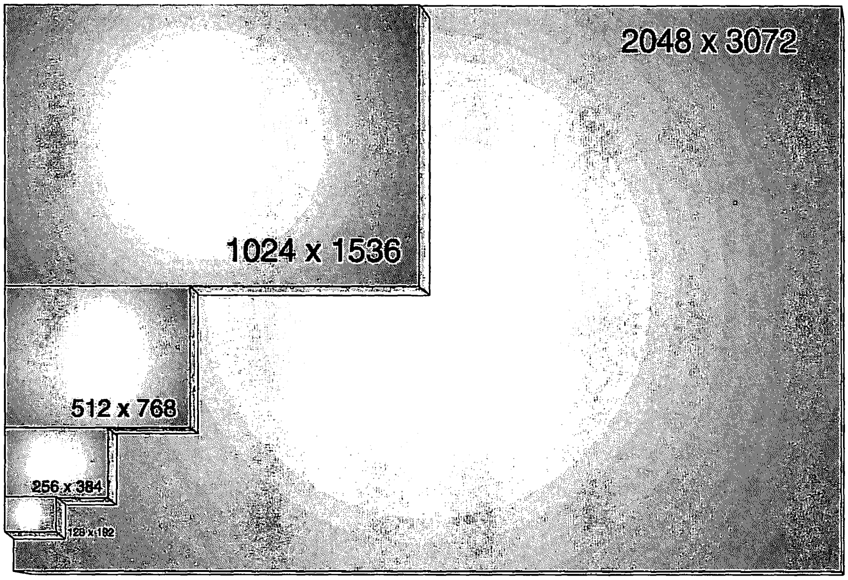


Photo-CD image formats

All the resolutions for a picture are stored in a single file. Storing images in different resolutions goes back to the original intent for Photo-CDs. Namely, with a Photo-CD player you can only display pictures in their stored sizes. Scaling and recalculating resolution are not possible with the Photo-CD player. An alternative for the PC would be to store only a high-resolution format which would then have to be recalculated to lower resolutions, with a corresponding decrease in operating speed.

In addition to image data, now you can also store audio data on a Photo-CD.

PRO-Photo-CD

Kodak uses the prefix PRO for CDs capable of storing extremely high-resolution photos. In addition to the normal Photo-CD formats you can also use the Base/16 resolution. The number of horizontal and vertical pixels is twice that of Base/4n this resolution. The maximum resolution of 4,096 x 6,144 pixels is especially suitable for professional use. Due to its capability of storing high-resolution pictures, the number of pictures on a PRO CD (approximately 25 pictures) is much less than that of a normal CD.

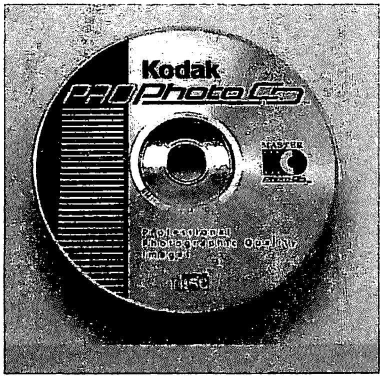


Photo-CD Masterdisk

Portfolio-Disc

A Photo-CD format has been developed that also stores audio data. This is a result of the universal demand for multimedia. It accommodates CDs up to Base resolution, to which you can add sound or text as desired. The maximum capacity is listed as 800 photos or 1 hour of audio. Normally, however a middle range is normally used, such as 400 photos with 30 minutes of music.

Portfolio-Disc

Catalog-Disc

This new format allows storage of up to 4,500 pictures. Resolutions higher than Base are not available.

Catalog-Disc

Medical Disc

This Photo-CD is used for medical/diagnostic purposes.

Photo-CD formats					
	Photo-CD	PRO Photo CD	Portfolio Disc	Catalog Disc	Medical Disc
Digitization of Film/Slide/Negative		35mm	to 4x5"	X	
Digitization of images		X	X	X	X
Base /16	128x192 pixels	X	X	X	X
Base /4	256x384 pixels	X	X	X	X
Base	512x768 pixels	X	X	X	X
4 Base	1024x1536 pixels	X	X		
16 Base	2048x3072 pixels	X	X		
64 Base	4096x6144 pixels		X		
Image capacity (without audio)		100	>25	800	>3000
Audio capacity (without images)		60 min		60 min	

Photo-CD costs

To order a Photo-CD, you send your film to a qualified dealer. You can recognize a qualified dealer by the Photo-CD logo on the store window. The dealer will forward your materials to a large developing lab. Since the equipment required to make a Photo-CD (sold by Kodak) starts at $250,000, not every dealer can afford to offer this service.

For the consumer however, obtaining a Photo-CD is relatively economical. The costs are broken down as follows:

Blank CD:	$9.50
Cost per recording session	$3.00
Cost per print	$0.75
Special handling costs per print: (i.e., enlargements or clippings)	$1.50
Copying photo-CD onto photo-CD per print:	$3.00

Total costs to transfer a 36-exposure slide film come to approximately $20.00 to $40.00.

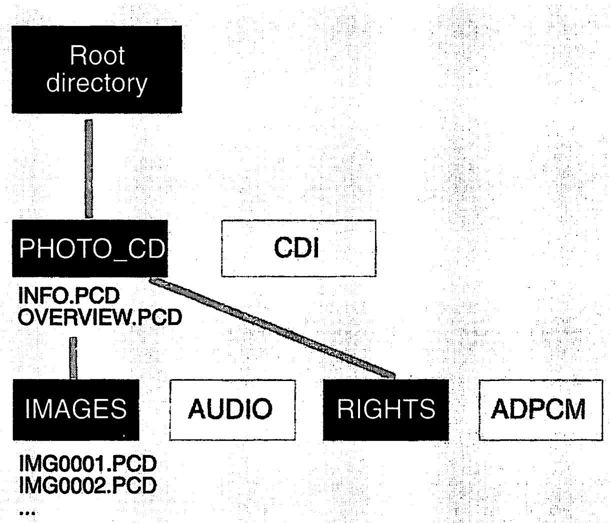
Creating a Photo-CD

As we mentioned, the Photo-CD manufacturing process requires a laboratory with extensive technical equipment. Before the CDs can be imprinted - with Kodak this is done by PCD-writers - the original photo materials must be digitized. This is done using high-performance scanners. Once the pictures are scanned and digitized, before finally being written to the Photo-CD, they undergo a control process where corrections can be made for sharpness and color intensity.

Data layout on the Photo-CD

Files and directories on the Photo-CD always follow the same layout.

CD Complete: Put It In Action



All photos and associated data are located in the PHOTO_CD directory. The CDI directory is for future CDI applications.

Initially the PHOTO_CD directory contains two files. The file OVERVIEW.PCD contains all images on the CD in low resolution. The INFO.PCD file contains such information as the CD's serial number and manufacture date. Then for each photo on the CD, the IMAGES directory has a file with the extension PCD. The first file is called IMG0001.PCD, the second IMG0002.PCD etc. These files are also known as ImagePac. Here in addition to resolution, you can store other information such as image date, image origin etc.

Using Photo-CDs

To use a Photo-CD, you need a Photo-CD-compatible (XA-compatible) drive that also has multisession-capability. If you don't have such a drive, you won't be able to access the images.

When reading a Photo-CD, if you get an error message like Drive not ready or something similar, the first thing you should do is check whether your drive truly is Photo-CD-compatible. If so, the next step is checking the medium - often all that's needed is a quick wipe with a dust-free cloth. Finally, you might need to recheck your entire configuration. If it turns out that your drive is not Photo-CD-compatible, your only choice is to buy a new one.

To access data on a Photo-CD, you need software that can read the Kodak PCD format. One such program is Photo-CD Access, offered by Kodak itself for $43.00. Also CorelDRAW!, starting with Version 4.0, has a PCD import-filter. Note, however, there is no "access software" on a normal Photo-CD.

CD Complete: Put It In Action

The companion CD-ROM contains a shareware program for accessing Photo-CD data called Paintshop Pro. To install Paintshop Pro, call the SETUP.EXE file form the \GRAPHIC\PSP directory.

It's on the companion CD-ROM: You'll find Paintshop Pro in the \GRAPHIC\PSP directory.

For extensive documentation on Kodak Photo-CD, including all aspects of digital image processing as well as several sample images, refer to *The Photo CD Book* from Abacus (see the "Abacus PC Catalog" in the back of this book for more information).

Videos And Animation

PC videos started to appear about two years ago. Since then, they're steadily increased in popularity. PC videos are miniature videos which can run on a PC with no additional hardware. The PC functions both as video recorder and editing table.

It's actually remarkable that videos and PCs can work together because they were designed for different purposes and certainly not for each other. The biggest challenge for a PC is being able to handle the massive amounts of data. Fortunately, the CD-ROM is able to help this problem. It's no wonder that video is finding a place on the PC because of the ability of the CD-ROM to store huge amounts of digital video data on the PC.

From VCR to monitor - video and PC

Now we can play on the computer. First we have to capture the video data. Now we'll begin to see the incompatibilities. The technical specifications for VGA signals and video signals have practically nothing in common, as we soon see.

The three major television broadcast standards are: NTSC, PAL and SECAM. In order they are: NTSC (National Television Standards Committee); PAL (Phase Alternation Line); SECAM (Systeme Electronique Couleur Avec Memoire).

Video image on TV screen	VGA image on monitor	
Resolution	700 x 525 (NTSC)	800 x 600 or 833 x 625 (PAL) 1024 x 768 1092 x 819 (SECAM) 1600 x 1200 maximum
Refresh rate	US/Canada: 60 Hz Europe/Asia: 50Hz usually non-interlaced	
Signal type	Composite	RGB w/synch

Resolution

In the above table, the first category refers to the resolution. A standard NTSC television has 525 scanning lines. The proportion of horizontal to vertical lines is called the aspect ratio. For televisions, this ratio is 4:3, so the vertical resolution is 700.

Screen refresh rate

The next category in the table compares the screen refresh rate, also called the regeneration rate. The human eye perceives movement in a video from individual images which change rapidly. When the number of images displayed reaches 15 to 25 per second, it interprets the sequence as continuous. However, a steady non-flickering image on a monitor requires a far more frequent update. A refresh rate of 25 Hz, meaning a display of 25 images per second, is impractical.

The frequency for televisions in the US and Canada is 60 Hz and corresponds to the standard power supply frequency (50 Hz in Europe/Asia). In any case, the television does not show 60 complete screens per second. Instead, it shows only half of the screen at any one time (called a field); the odd and even horizontal lines are displayed alternately.

When only half-screens are displayed each time, we speak of an interlaced display. Two fields displayed alternately make up a frame. The table shows that the image frequency is always higher on computer monitors than on television sets. For ease of viewing, it should be as high as possible.

Signals

The last category in the table compares the signals that are used. Computer monitors are controlled by RGB signals. Three different circuits transmit levels for the red, green and blue color components of an image. Another line synchronizes the image frequency. This is different from televisions. Here, the picture tube uses a process that is compatible with the ancient black-and-white televisions. Composite consists of video, audio and sync signals.

Compared to the RGB signal of the VGA monitor, composite technology has several weaknesses. For example, one of the weaknesses is the representation of contrast.

In the upcoming months, we'll probably hear more about a new television development - HDTV. This stands for High Definition television and has a resolution of about 1,100 lines at 1,920 pixels per line, giving an aspect ratio of 16:9.

Video capture cards

Because of this incompatibility between TV and VGA images, displaying television or videorecorder signals on a monitor is not so simple. Converting the FBAS signals to RGB signals is an enormous task. Designed specifically for such tasks are what we call video capture cards. The video capture card digitizes the video signal, which is then transmitted to the monitor directly from its own video memory.

The video capture card superimposes the video image directly onto Windows

The function of the video capture card is to take the incoming video signals, and in real-time, (no delays), to digitize them. The basic principle here is similar to that of digitizing audio samples, as discussed earlier. In this case, however, the digitization must proceed much faster, 60 (50 in Europe) half-screens per second.

The scanning frequency, instead of the 11 to 44 Kilohertz needed for sound, is in the 10-Megahertz range. This means that the analog input signals must be scanned more than 10 million times per second. Along with this enormous scanning frequency comes a correspondingly higher resolution. To digitize a video image without loss of color, a TrueColor; (16.7 million colors) transfer requires a resolution of 24 bits.

Even so, outstanding results can still be achieved with a 16-bit sampling resolution. The amounts of data produced here are so enormous the PC memory and expansion bus are insufficient. Instead the data must travel via the video capture card, which has its own video memory or video-RAM, directly to the monitor.

CD Complete: Put It In Action

This is also how the video capture card gets its name. The video image overlays the VGA image; it is actually superimposed on a one-screen area of the VGA image. The video data exists neither in normal memory nor on the hard drive.

One way the video capture card accesses the video data is known as "frame-grabbing". Instead of the entire video sequence, only the data from a single picture, or frame, is accessed. Special software included with the video capture card freezes the video image, reads in the video-RAM of the video capture card and makes the data available to the computer. This function is called grabbing. Virtually all video capture cards have this supplementary function called a frame-grabber. For saving the images, you might have to adjust the color-resolution of 24 bits to the color-resolution of the VGA card. In addition to color-resolution, settings for file format are also commonly provided.

Data compression

Before you can capture an entire series of frames (to create a complete video clip) on the hard drive, you must overcome the data quantity problem. To view such a video sequence in TrueColor, that is with a 24-bit color resolution, on a full-size screen of 800 x 600 pixels, a single still frame would take up over one megabyte of space. At 25 frames per second and a film length of only four seconds, you would already have 100 megabytes of data. Aside from the fact that such a quantity of data would exceed all boundaries - a 650 Meg CD-ROM would accommodate exactly 26 seconds of film - there is no bus system and no storage medium capable of transmitting 100 Meg in four seconds. The key to the solution here is data compression. Needed is a data compression process that not only achieves a high compression rate but also allows for decompression of data in real-time.

Three different types of data compression have emerged:

1. Software only compression. Videos are compressed by software and decompressed by software.
2. Videos are compressed through hardware-support, but can be played on any normal PC with no additional hardware.
3. Special hardware is used for both compression and decompression.

First, the software only solutions. Here are included the Indeo process from Intel, and Microsoft's Video1/Video2. Both processes work with no additional compression hardware and are used in various programs such as Video for Windows by Microsoft.

Both processes use similar strategies for reducing data volume. First the video size of 800 x 600 pixels (or 640 x 480) is drastically reduced, for example to 160 x 120 pixels, the image area and thus the data quantity shrinks to one sixteenth the original. The color-resolution of TrueColor (24 bits) is reduced to 256 colors (8 bits).

Until now, the amount of data per individual frame has already decreased by a factor of 48. Added to this is the highest reduction possible in frame rate, or images per second. From the full-motion video of television, requiring 25 (complete) frames per second, values drop to between 15 and 18, just barely maintaining the illusion of motion. This achieves a further data reduction of up to 40%. Finally both processes employ various algorithms to eliminate storage of images in their entirety. Instead only the information that changes from frame to frame is stored.

For example, if a particular frame differs from its predecessor by 10% of its pixels, the program stores only that 10%. In reality of course these algorithms are more complicated - also recognized are parallel shifts etc. Even so a further substantial reduction is possible here, depending on the type of video. There will be less reduction with fast-moving videos than with very still ones.

Both these processes yield "scalable" results that adapt themselves to your particular PC system. The higher the overall performance of your system the better the results. In both programs you can set parameters such as frame rate and video size to provide the optimal match for your system. When optimizing there are two different directions you can take. Either you decide on a large video window, in which case you might need to lower the frame rate, or you place greater value on a smoothly flowing image so you raise the frame rate, in which case you would reduce the video size.

Possible settings

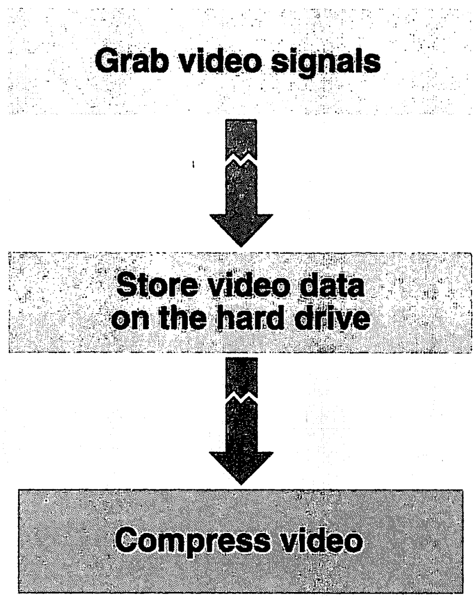
Possible settings are listed in the following table:

Processor	Optimizing with respect to Video window size	Optimizing with respect to Frame rate
80386DX-40Mhz	320x240 pixels, 6 frames/second	160x120 pixels, 15 frames/second
80486DX2-66MHz	320x240 pixels, 12 frames/second	180x150 pixels, 25 frames/second

Of course these guidelines can certainly be exceeded. In any case you will obtain the best results by selecting a balanced relationship between window size and frame rate.

Installing a digitizer board

The first order of business is to "grab" or digitize the video signals. Digitizing and storage on the hard disk represent the first step. Then the image is compressed so you can start to replay it back from the hard drive.



Installing a digitizer board is not very complicated. Like other boards, you begin by setting the interrupt, I/O base address and DMA channel. Here it can get rather crowded, especially if your computer is already outfitted with numerous expansion cards such as a CD-ROM interface and sound card. One particular problem with digitizer boards involves the video memory used by these boards. On many boards, the address range for this video memory is set to between 15 and 16 megabytes in main memory. Now if there are 16 Meg of memory available, the last megabyte can never be used. Otherwise collisions would occur between main memory and video memory. Unfortunately, however, it's not possible to just clip off the last megabyte of memory.

The main memory consists of SIMM modules which are arranged in banks. On most motherboards these banks must be filled with the same size SIMMs, which means that in many cases the computer must be reconfigured down to 12 or even 8 megabytes. Therefore, when buying a digitizer board, find out whether it also works in a system with 16 or more megabytes of memory.

Digitizer boards variations

Digitizer boards are available in many forms. There are two interesting variations.

Digitizer boards with an integrated VGA card

The first variation of digitizer boards are those with an integrated VGA card. This type of digitizer board has two advantages:

- Saves on expansion slots which you can use for other purposes.
- The VGA card and digitizer board are matched.

However, it also has some disadvantages:

- Exchanging the VGA card independently of the digitizer board is difficult if not impossible.
- Some digitizer boards feature real-time compression which is different from the hardware and software compression methods mentioned above, rather with the fact that very often when grabbing videos, not enough data can be written to the hard drive.

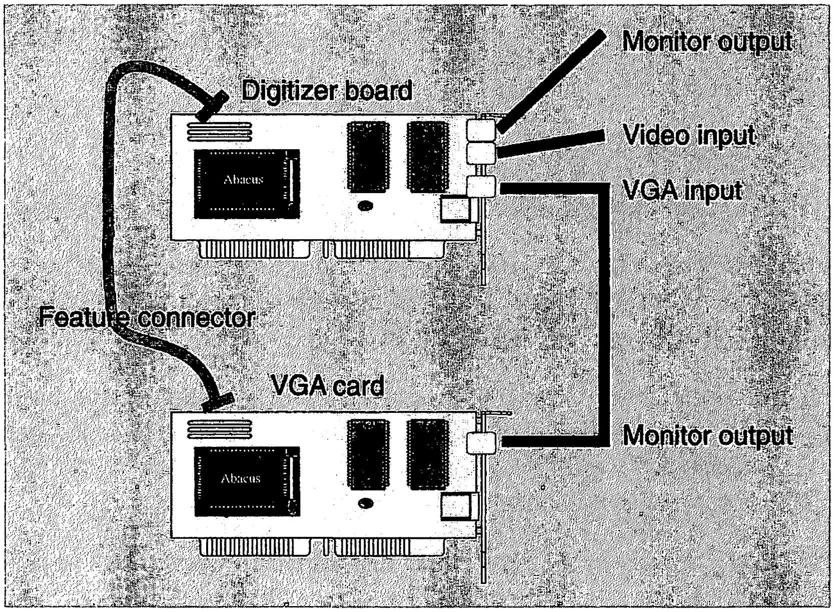
Before videos can be saved in Video for Windows for example, using the Microsoft Video 1 compression process, the first step is grabbing them - i.e. digitizing incoming video signals in real-time and saving them on the hard drive. On digitizer boards without real-time compression the volume of this data is limited and therefore the video size and frame rate is also limited.

By installing a real-time compressor you can write more data onto the hard drive for later processing. With a conventional digitizer board you might miss out on some of the software compression options, since not enough data made it to the hard drive during digitization. Already at the recording stage, data compression make possible larger window sizes and higher frame rates.

Digitizer boards without built-in VGA

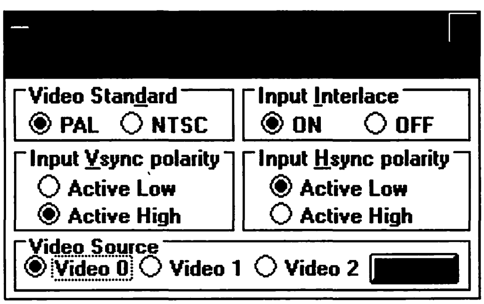
When installing a digitizer board without built-in VGA, look for a slot close to the VGA card. Next, internally connect the VGA and digitizer board with the connector. Naturally, this requires the VGA card to have a connector. Connect the monitor directly to the digitizer board the monitor output jack of the VGA card is connected to the VGA-IN jack of the digitizer board. Incidentally, on most digitizer boards you can connect up to four video sources and one audio source. To sample audio data from a video, connect the audio cable (of the videorecorder for example) directly to the LINE-IN jack on the sound card.

CD Complete: Put It In Action



Connecting a digitizer board

Once you have installed the card and connected the cables, the next step is running the SETUP program. This installs the necessary drivers for DOS and Windows, makes entries into the system files and asks you for certain parameters, such as the type of video system being used. Finally, in a special window (Align Video) the video image is aligned in its assigned window.



Fine alignment

Video for Windows

Video for Windows in its full version not only lets you view videos, you can also digitize - here it's called capture - edit and compress them. Video files processed by Video for Windows all carry the extension AVI - an acronym for Audio Video Interleaved. This means that audio and video data are stored in interleaved format.

In addition to the full version, there is also a runtime version, which you will find on the companion CD-ROM. The runtime version lets you decompress videos in real-time.

Installation of Video for Windows Runtime 1.1

To install the runtime version, go to the \PROGRAMS\VFW directory on the CD-ROM and start the SETUP program. As usual, this is done by activating the **Run** command in the **File** menu, from either the File or Program Manager.

It's on the companion CD-ROM

To install the runtime version, start the SETUP program from the \PROGRAMS\VFW directory.

Video for Windows Setup

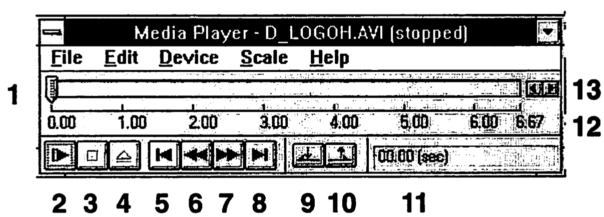
When you run SETUP, the first thing that appears is an introductory window. Click on [Continue]. Towards the end a window appears on the screen called Profiling Display. Here Video for Windows checks your system and determines a number of initial settings for image playback. Playback quality depends on a series of factors such as processor, bus system, graphic card, etc.

Installation is complete following the test.

Closing message

With the full version you are given a choice of three installation levels. Playback Only installs only the play software. This would make sense if you have no digitizer board and do not intend to edit videos. The Video Playback and Video Tools option sets up software for digitizing and editing. The third and most extensive level, Video Playback, Video Tools and Multimedia Tools, installs additional programs for editing bitmaps, sound files and color palettes. In each case you are asked at the end if you wish to also copy a sample AVI file.

Playback of AVI clips

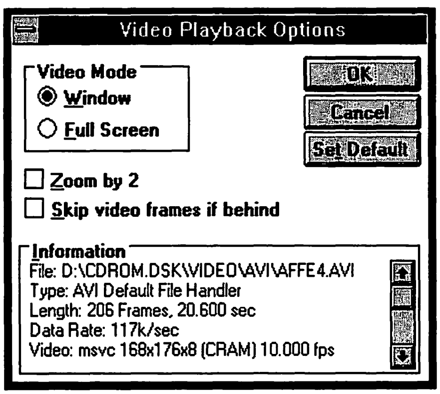


Windows Media Player

1 Slider and track bar
2 Play button
3 Stop
4 Eject
5 Previous mark
6 Page left
7 Page right
7 Page right
8 Next mark
9 Mark in
10 Mark out
11 Current time
12 Total time
13 Frame-by-frame browse

To play a video, select the **Open** command from the **File** menu. In the File window you can go to List Files of Type and enter Video for Windows (*.AVI). Only the AVI (video) files will then appear. Once the file is loaded you can run it with Play, move through it frame by frame, fast-forward, rewind etc. The videos normally play in a separate window to move the two windows together, double-click the title bar of the Media Player or press Ctrl + W. This reduces the available buttons to Play, Stop and a miniature version of the arrow, but makes playing the clips easier to control.

The **Configure** command in the **Device** menu offers several video display options. For example, if your PC has the capability, you can double the display size (Zoom by 2) or expand it to cover the entire screen (Fullscreen). The resolution however stays the same in both cases. In Fullscreen, Video for Windows switches its VGA card to the 320 x 240 pixel mode.



Playback options

Another optional setting is Skip video frames if behind. The effect is to always preserve the original playback time of the clip. To do this it is sometimes necessary to simply leave out individual frames. On slower PCs it may therefore be better to switch this option off. The videos will run somewhat slower but there will be no jerky movements. The Set Default switch saves the current settings for future clips.

Recording AVI clips

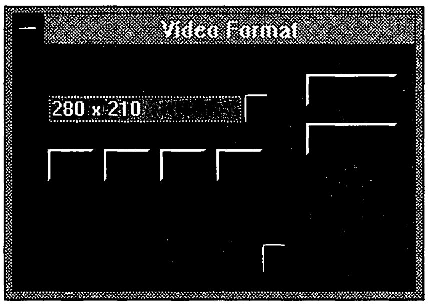
While the above playback functions are included in the runtime version as well, only the full version can digitize incoming video signals. Also required of course is a digitizer board.

Although in principle you can also record individual frames (step-frame recording), digitizing video signals from a camcorder is really practical only when you record the entire video. The video is then saved in real-time as an AVI file on the hard drive. At this point, however, it is still not in a playable form because it is uncompressed. Once compressed and written to a CD-ROM master, you can play the video just like any other clip.

CD Complete: Put It In Action

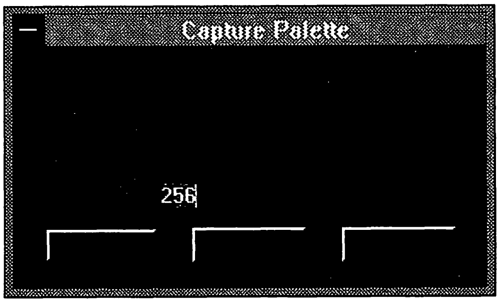
The digitization process requires a program called VidCap. The first task this program performs is creating a capture file. In this case digitization cannot proceed in main memory as usual, due to lack of space. Therefore in the **File** menu, select **Set Capture File** and enter a filename. At the same time you should also set the file size. This value should be as large as possible - each minute of recording requires about 20 Megabytes of storage space, which incidentally should be unfragmented. You may need to first defragment your hard disk with a program such as DEFRAG.

Before you actually begin digitizing, you must make a few more adjustments. The **Video Source** command from the **Options** menu sets the video signal type and the input being used. Videoformat from the same menu lets you enter window size and color resolution in bits. Here 8 bits represents 256 colors, 16 bits 65,535 colors and 24 bits 16.7 million colors. Both values are dependent on your system capabilities, i.e., how much data it can write to the hard disk in real-time. Clearly a real-time compressor (as discussed above) will accomodate larger values. Since the entries depend on many factors, we recommend initially working with the default values and then experimenting with them. After each action you would check whether your system can handle the new settings.



Videoformat window

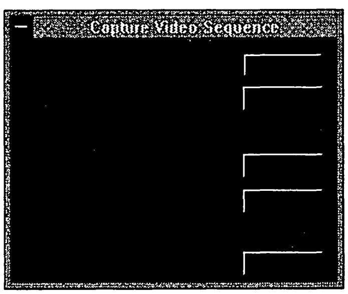
Furthermore, in the **Options** menu you can choose between **Preview Video** and **Overlay Video**. Overlay-mode displays the unchanged video signal using 24 bits. Preview-mode shows the digitized, reduced-color version. The latter requires slightly more processing but gives you an immediate idea of the video's quality. With a setting of 8 bits it's a good idea, prior to digitizing the video signal, to first capture the palette. Otherwise your video may end up as black-and-white. To base the palette on a series of frames, start the videorecorder and select Start in the Capture window.



Capturing palette

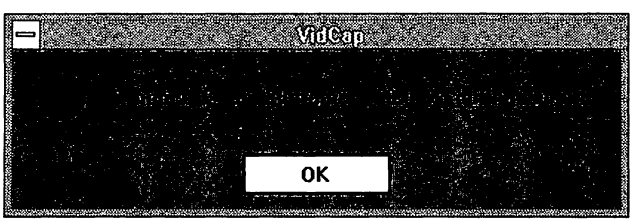
The optimal palette is generated when you close the Capture window. You can then rewind the videorecorder back to the beginning, and finally begin the digitization process.

The **Video** command from the **Capture** menu takes you to a window where further settings can be made. The first entry here is frame rate. Although you would like a value as high as possible, make sure it is actually supported by your PC.



Video options

After the option for setting a time-limit, you can enter whether you wish to record sound at the same time (Capture Audio). Keep in mind here that the audio output of the video source should be connected to the LINE-IN jack on the sound card. Upon closing the window with OK and entering the **Start** command, the recording will finally play. You can cancel play by clicking the mouse or pressing Esc.



Dropped frames

Before you go back to the main screen, the program will tell you how many frames were dropped, or omitted. A value over 20% will cause noticeable jumps in the video as it plays. In this case you should try it again while reducing the frame rate or window size. Certain system parameters also effect the results

of real-time digitization. As mentioned, a defragmented hard disk works faster than a fragmented one. Better results are also possible by turning off the DOS-switch VERIFY, by adding the following line to your AUTOEXEC.BAT file:

```
VERIFY=OFF
```

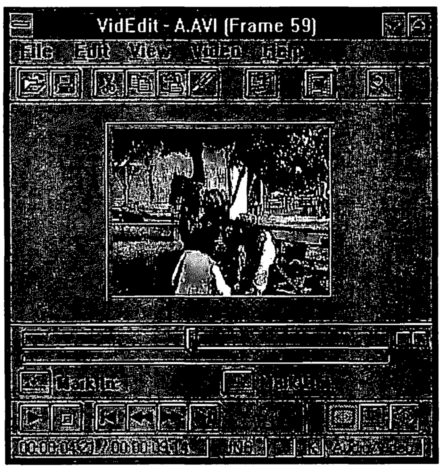
Another tactic is to turn off the SMARTDRIVE write cache, using the following DOS command:

```
SMARTDRV C: /C
```

Now if everything has proceeded correctly the video will be recorded as an AVI file. Even so, it's not quite ready for smooth playback. First you'll have to edit and compress the video, by loading it into the VidEdit program.

Editing videos with VidEdit

You can run VidEdit directly from VidCap, using the current AVI file, by selecting the **Edit Captured Video** command from the **File** menu.



The VidEdit program

VidEdit provides several additional editing options - adjusting video window size, removing sections, combining multiple videos, adding soundtracks etc.

The most important task of VidEdit however is software compression. In compressed form the digitized video is viewable directly from the hard drive at any time.

To specify the compression settings, activate the Compression Options switch under **File/Save as**. The first setting is the medium from which the AVI file is being played. This may be the hard drive, but it may also be the CD-ROM drive. You can select a data transfer rate for the CD-ROM drive, between 150K/sec and 300K/sec. By using this, even if the transfer rate is only 150K/sec, the AVI files will play smoothly from the CD.

There's also an option to select a video-compression method, whereby you change the initial setting of Full Frames (no compression) to Microsoft Video 1, Intel Indeo or one of the newer methods. Compared to standard files, software compression can take a very long time. Clips that are minutes in length may require compression times measured in hours.

The CD-ROM that accompanies Video for Windows contains several different versions of the same video clip: Compressed by Intel Indeo 3.1 as FLY150KB.AVI for CD-ROM 150K/sec and as FLY300KB.AVI for CD-ROM 300K/sec, and compressed with Cinepack using the option CD-ROM 150K/sec saved as FLYINDEO.AVI.

Hardware compression

Since hardware compression is becoming more popular, we'll present two boards and describe them.

MiroVideo DC1

In contrast to its predecessor, this card uses a real-time compressor. The compressor operates according to the Motion-JPEG compression process. JPEG is the abbreviation for Joint Photographic Expert Group. JPEG was originally a standard for compressing single images. Only later was compression of image sequences added to it, hence the name Motion-JPEG.

JPEG is capable of digitizing videos of size 576 x 768 pixels and at 25 frames per second in real-time. The data is reduced to approximately 20 megabytes per minute of video, which requires a data transfer rate of about 350K/sec, attainable by most average SCSI hard drives. Since the card is also designed to output data to TV equipment, its ultimate purpose is clear. The PC can then function as a kind of videorecorder. In combination with video-editing software such as Adobe Premiere, you now have the capability to edit videos digitally. This capability is sometimes refered to as Desktop Video.

More promising than the Motion-JPEG standard, however, seems to be MPEG, a similar process, but which from the beginning was designed just for compressing videos. To start things off, only MPEG stores changes between two successive video frames. The compressed videos require one-third to one-half the storage space of a comparable Motion-JPEG video. On the other hand decompression in MPEG

is much more involved. Although it's possible to decompress MPEG videos using software, the results are less than adequate. Playing MPEG videos generally requires a special card. One such card is Real Magic from Sigma Designs.

Sigma Designs Real Magic

This card provides a specific playback resolution for MPEG videos. The end results are quite impressive. Video and animation sequences run at a frame rate of 24 frames per second in a window measuring 354 x 288 pixels. You can enlarge the window size up to 1024 x 768, whereby the missing points are calculated by interpolation, which eliminates the "terraced" effect.One problem with MPEG is the availability of software. MPEG videos are rare. Whether MPEG will finally evolve as the standard format for video clips is still unclear.

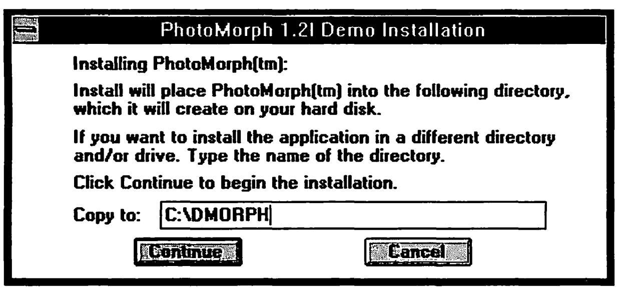
Fantastic effects with PhotoMorph

Now that you are familiar with the digitization of videos and how they're edited and compressed as AVI files, you'll have a chance to create your own videos with the software on our companion CD-ROM. No digitizer board is necessary, nor is the full version of Video for Windows. Of course you won't be able to retrieve videos from other sources. The program generates special animations, actually fade-out and transformation effects. A program called PhotoMorph from Softline, is included on the companion CD-ROM as a demo version with a limited range of functions. With this program you can generate "morphings". For input, Photomorph uses bitmaps of all kinds (only in the full version - in the demo version acceptable image formats are limited), and produces AVI files as output. You can then edit these AVI files in VidEdit or play them with the Media Player.

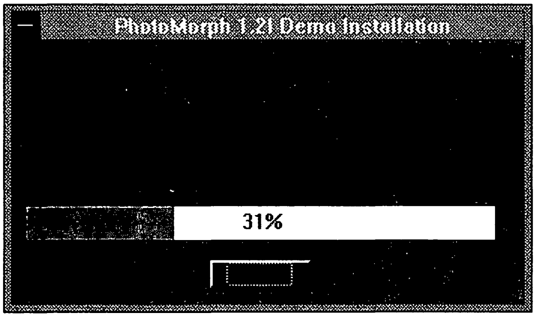
It's on the companion CD-ROM

To install PhotoMorph, call the INSTALL.EXE from the \VIDEO\MORPH directory.

To install the PhotoMorph program, call INSTALL.EXE from the \VIDEO\MORPH directory. In a few moments the installation program asks you to confirm the target directory name or enter a new one.



Photomorph installation

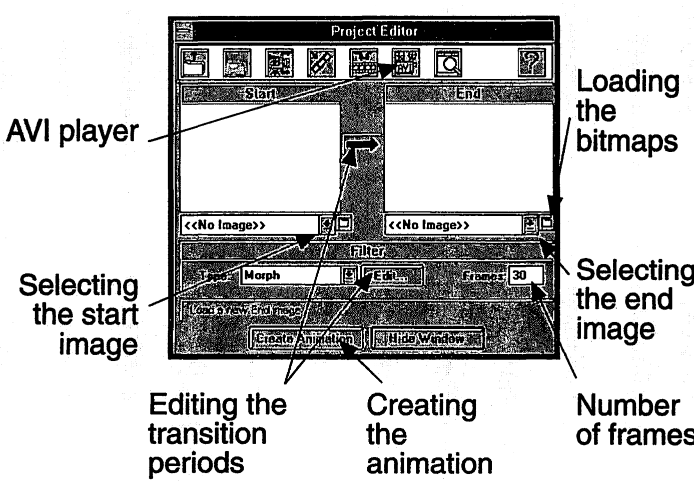


The copy process

Press the [Continue] button to install the program and eight pictures, which you can use to test Photomorph. To help you get started we'll describe the transformation of a frog into a chicken.

Morph objects

The first thing that comes into view with PhotoMorph is the Project Editor, the point from which you control the animation process. You will see two (still empty) windows, which will later display the initial image and the target image. Beneath the windows are list boxes containing all loaded graphic files for selection.

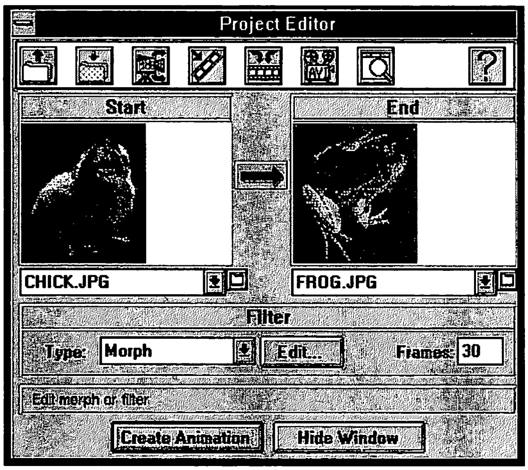


Photomorph functions

CD Complete: Put It In Action

Step 1: Loading the raw material

The first step is to load a bitmap. In our example, we'll use the sample files that come with the program, CHICK.JPG and FROG.JPG, located in the same directory as the Photomorph demo software. To select a file, simply click the button next to the list boxes and confirm with OK. It makes no difference which of the two buttons you use. We suggest however retrieving the initial file with the left button and the target file with the right button. This way the pictures will already be in their proper windows. Otherwise you can change selections using the list boxes underneath the window. Either way the images in the Project Editor should look like this:



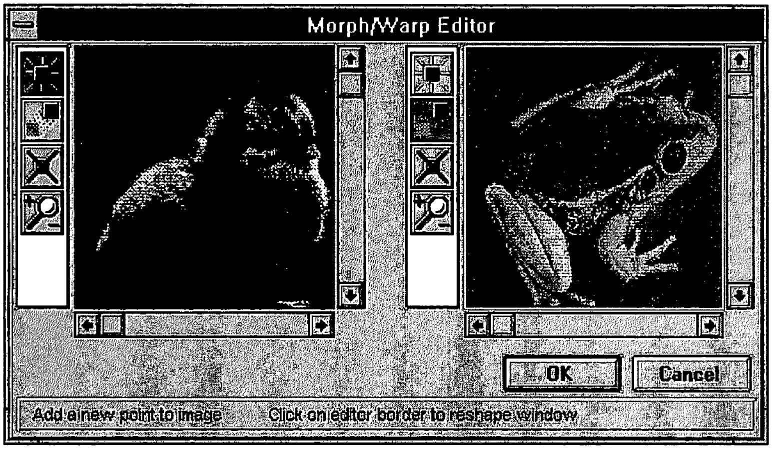
Project Editor

Step 2: Editing transition points

Instead of just letting you superimpose images, a special feature of PhotoMorph lets you set "transition points" which appear on both images in reciprocal fashion. For example you can place transition points on the eyes of both images, which produces a motion effect. One eye "moves" toward the other one and in the process it changes. To create these transition points, click on the arrow between the two windows. In the Morph/Warp Editor you now see the same two pictures but with four tools on their borders. These tools have the following functions:

- The top tool is for setting the transition points (it's preset in the initial image).
- The second one is for moving (it's preset in the target image).
- The third one deletes the transition points.
- The fourth one enlarges the display, which can be reduced using the Shift key.

Here's one way to proceed: In the left window, set a transition point at a typical location. Its counterpart will appear at the same location in the target image. Now move this transition point in the target image to a suitable position - if the initial point marked an eye then the end point should mark an eye. The final result might look something like the following:



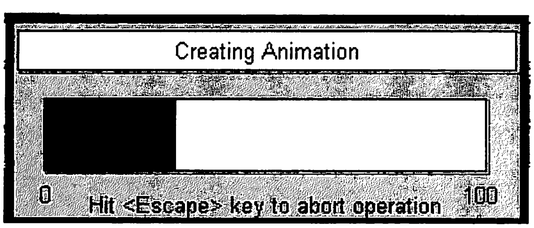
Morph/Warp Editor

Areas especially suited as transition points are borders, the interior of facial structures and any area of the image you wish to emphasize. The optimal number of transition points is determined by experimenting. In most cases however a dozen should suffice. Also remember the more points, the more calculation time is needed to create the animation. When you click OK you will return to the Project Editor.

Step 3. Creating and viewing animations

Before you start Create Animation you can still change the number of frames, although the preset value of 30 is usually adequate. This means that at a frame rate of 15 frames per second you will get a clip two seconds long.

Once you click the button, the program asks you for the filename of the animation to be created. The default extension is already set to AVI, the video file format under Windows. The number of selected frames and the number of transition points determine the amount of time to complete the animation.



Creating the animation

Since the output creates an AVI file, many programs can be used to view your results. For example, the Media Player or the programs on the companion CD, MEDVIEW or VidEdit. Photomorph also has its own program called AVI Player.

To start the AVI Player click its corresponding icon in the bar. The first thing the program asks for is the name of the file to be loaded. Once you have selected the file and confirmed with OK, just press the Play button on the AVI Player.

Animation with CorelMOVE!

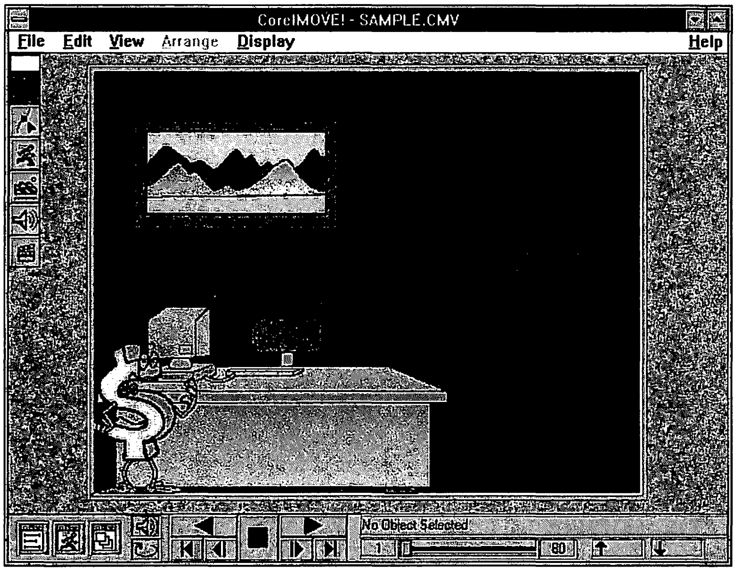
Another program for creating animation in AVI format is CorelMOVE!, part of the CorelDRAW! 4.0 package. CorelMOVE! lets you create your own cartoon clips. Since the program has so many features it takes some practice to put them all to use. To start you off, we'll create a short animation using only tools offered by CorelDRAW!.

Step 1: Setting the background

When you first start CorelMOVE! the program window is empty. To create an animation select **New** from the **File** menu and either confirm the existing filename or enter a new one. An animation basically consists of three components. The first is the background. The second is known as a requisite, which appears for a specified time interval but does not change throughout its video life. The important components of the animation are actors, which are responsible for movement. Actors not only appear for a definite time period but they also carry out some form of motion.

The first thing we'll do is set the background, since we don't want our actors moving about on a white surface. All raw materials will be retrieved from the CorelDRAW! archives found on the CD-ROM. To do this place the second CorelDRAW! CD-ROM into your drive (CorelDRAW! - Disc 2).

To provide access to the archives, click the appropriate Archive button on the bottom of the Archive Rollup window.



CorelMOVE! options

Archive Rollup is a free-floating window that lets you access the archives. When you press the button for the first time there may not be anything in the Rollup window. Open an archive by clicking on the corresponding arrow and selecting the **Open Archive** command. Then in the dialog box go to the \MOVE\LIBRARIES directory on the CD-ROM drive. For the background select as an archive the list PROPS1.MLB.

In the Rollup window you can now scroll through the various backgrounds and when you see one you like, retrieve it into the animation with the **Load** command.

Inserting actors

We now need to add an actor to go with the motionless background. Just like the background, the actors will also come from an archive. Open the archive as before, only this time select ANIMALS.MLB as the archive file. Here also you can scan through the elements with the scrollbar. Somewhere in the middle you will see the tiger. Click the [Insert] button to transfer the currently displayed contents to the animation. To move the actor, select the marking arrow. If you plan to make the tiger run across the screen, first move it to the left window border.

Setting the actor in motion

To breathe life into the actor, a tool is provided for setting "motion points". Between each motion point a line is drawn along the path of motion. Each motion point thus marks the actor's position for one frame.

At any time during this process you can run the animation using the buttons at the bottom of the window.

A few tips for experimenting with CorelMOVE!:

When setting motion points, you can automatically increase/decrease their number by pressing the + or - keys along the path of motion in the Rollup window and entering the desired number. The original path is then evenly filled with the designated number of points. To change the actors' sizes while they are moving, use the Arrange Cells tool.

Creating AVI files

To create an AVI film with CorelMOVE!, call the **Export to Film** command from the **File** menu, and your show will appear as an AVI file.

Additional CD-ROM Applications

A rough estimate suggests that there are well over 15,000 CD-ROM titles available worldwide, with their numbers expanding rapidly. Even CD-ROM catalogues, which themselves appear on CD-ROM, are out of date as soon as they come out. We'll therefore not attempt to provide a comprehensive list which would remain ever incomplete, rather we will present various software categories distributed on CD-ROM.

There are three main categories of CD-ROM software: First, there is software that has always existed, shareware collections for example. Then there are programs which although they've been around a while, have undergone substantial changes in response to the development of CD-ROM. Included here are games, as well as application programs. Finally there is completely new software which arose almost simultaneously with CD-ROM, such as multimedia collections and applications.

In addition to shareware and clip art collections, the traditional software also includes programming tools. CD-ROM provides an excellent transport medium for such collections. When purchasing this type of CD-ROM your decision should be relatively easy, since you know exactly what to expect. On the other hand it is just this type of software that points out the problem with CD-ROM. Some distributors have been quite aggressive in their approach to the marketplace. How else could one explain a CD-ROM shareware package selling for only $30.00?

Many consumers were so fascinated by the new medium of CD-ROM that high prices were almost expected - the actual contents of the CD was a secondary consideration. Naturally some dealers have taken complete advantage of this.

The sale of shareware collections has raised a number of other issues - fairly easy to cope with are the missing references to shareware registration fees. More difficulties arise however, when 500 or 1,000 programs in packed format are stored on a single CD-ROM in absolutely no order whatsoever. The user is forced to copy all the programs to the hard disk, unpack them and then test them. With 1,000 programs and a testing time of say 10 minutes per program this comes to 10,000 minutes or over 160 hours, the equivalent of a month's worth of work, just to sift through the contents of one CD-ROM.

In the meantime as the market has consolidated, consumers have become more demanding and such occurrences are actually rare. One lesson should be learned from this example though - a CD-ROM in itself is not necessarily valuable. You should always inquire about the exact nature of its contents. Sometimes you're better off buying a diskette with a single program rather than an expensive CD-ROM collection.

The next category of programs, software modified for CD-ROM, includes the usual application software. Putting applications on CD-ROM has many obvious advantages. Each new application, and here we also mean operating systems, issued partially or exclusively on CD-ROM should be seen as a welcome development.

Also belonging to this category, however, are games, which should be examined a bit more critically. As we will discuss further in the next section, programs in this category include those that have been copied exactly from a diskette version, those that have been expanded for the CD version (some insufficiently) and finally those available only on CD-ROM. Generally we would tend to go with the CD, although you should always check in each individual case whether the CD version really is superior to the diskette version and whether the extra cost is justified.

Even greater caution should be taken with the new multimedia software that has sprung up since the advent of CD-ROM. Here we have two very new technologies coming together. First of all, multimedia programs offer many promises, yet we have no direct means of comparing them. Combined with the already exciting new medium of CD-ROM, such products seem even more fascinating.

Some CD-ROM dealers have capitalized on this and offer collections of ordinary video clips for up to $125.00. Before purchasing a multimedia collection such as videos, animations, sounds or graphics make sure you are aware of exactly what it contains. Especially with this type of product, insist that the salesperson tell you the contents of the CD and its area of application. If necessary ask for a demonstration of the CD.

In addition to simple collections CD-ROMs also offer multimedia shows and multimedia presentations which enable you to retrieve the multimedia data. Here you should find out how much interactive input is allowed from the user and to what degree the data can be used independently of the program, i.e. for your own purposes.

Also belonging to the same category of new multimedia software are literature and newspapers on CD-ROM.

Equally as recent but far less unreliable are databases on CD-ROM, which come in all different types. The development of CD-ROM databases occurred along two different lines. First, CD-ROMs provide an alternative to on-line access of large databases via networks. This applies above all to specialized databases, such as economic or legal. Second, CD-ROMs also offer an alternative to various non-fiction books. It began with the transfer of reference works, encyclopedias and atlases onto CD-ROM. Next came multimedia elements such as sound, graphics, video and animation. The next phase is already evident - incorporating these elements into conventional non-fiction books. Imagine an auto repair manual, not as a dry set of instructions, but complete with graphics and videos. This represents not only the future of one of the most important applications of CD-ROM, that of information and education, but also the future of multimedia applications in general.

Selected CD-ROMs

The following is brief alphabetic list of available CD-ROM titles, representative of each area of application.

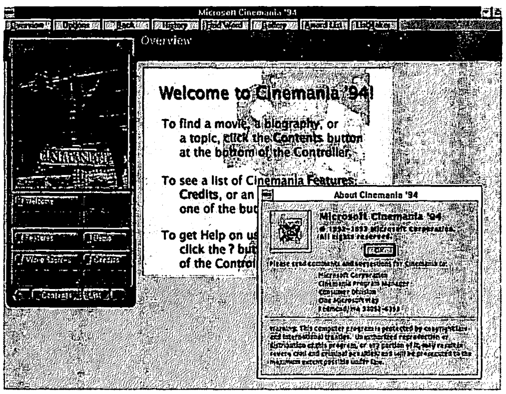
Compton's Multimedia Encyclopedia

Compton's Multimedia Encyclopedia

A conventional encyclopedia has been transferred to CD-ROM and illustrated with graphics, images, sound and videos. Bertelsmann is easy to use with fast search routines. The index includes 70,000 words.

Cinemania

This CD-ROM from Microsoft provides a complete film encyclopedia encompassing 12,000 feature films. Data given for each film includes actors, director, camera, film length, plot etc. The current version of the program however only has graphics no film clips are provided. In addition to information on the films the CD also includes actor biographies. The search program is easy to use and lets you switch directly between film and actor data.



Cinemania

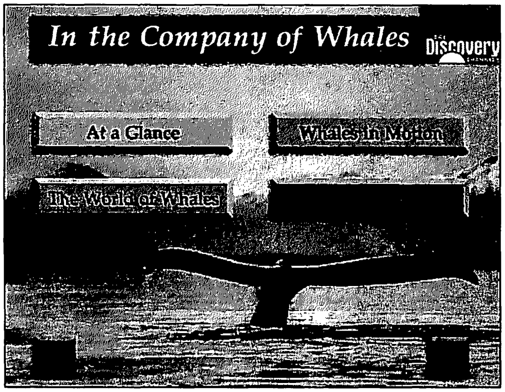
Media Visions for Windows 3.1

This CD contains a variety of software, such as the USA Travel Guide. One program in particular offers an outstanding new concept - an interactive feature film. Inside a window - unfortunately a rather small one - individual video sequences run their course. A menu then appears where the user decides how the plot continues. Additional video sequences follow depending on the selection.

In The Company of Whales (The Discovery Channel CD-ROM)

Take a spellbinding multimedia journey with nature's most spectacular creatures as never before captured on film - with some of the rarest whales on Earth. Includes 45 action-packed minutes of exclusive video, including humpbacks bubblenetting, blue whales feeding in icy Antarctic waters, and killer whales devouring a gray whale. And more than 200 photographs plus illustrations.

Requires a multimedia PC or equivalent, MS-DOS or PC-DOS, Windows 3.1 and MSCDEX V2.2 or later.

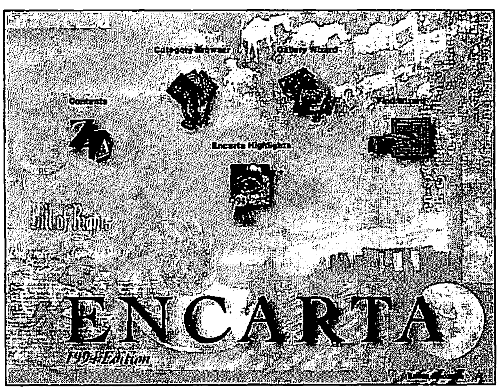


In The Company of Whales (The Discovery Channel CD-ROM)

Microsoft Encarta

Encarta is one of the finest CD-ROM encyclopedia for your PC. The innovative Encarta database starts with the Funk & Wagnalls 29 volume encyclopedia and adds more than 1000 articles, eight hours of sound, samples of 60 languages, 7,800 photos and illustrations, 100 animations and video clips, 800 maps, and much more!

Requires a multimedia PC or compatible, with 386SX or higher processor, 4Meg of RAM, at least 2.5Meg of available hard disk space, Windows 3.1 or later and mouse.



Microsoft Encarta

WinWare

WinWare is a superior collection of shareware programs, drivers, utilities etc., for Windows. This CD-ROM is issued twice yearly by CeQuadrat in conjunction with Vogel Distributors.

CD Complete: Put It In Action

What are authoring systems ?

Unlike software which is offered exclusively on CD-ROM, we'll discuss programs for processing multimedia data (which could exist on CD-ROM) in this section. The practice of multimedia involves not only purchasing or using applications, but also involves creating your own applications.

You can encounter very specific problems when you combine your own presentations or education systems and information systems from available texts, graphics, sounds, videos and animations. Programming the control software in a high-level language would likely become a costly and time-consuming task. Although, doing so would provide extensive access capabilities, but because of time and cost factors which play such an important role in multimedia applications - they must be fast and easily changeable - high-level language programming is not practical for this purpose.

An alternative is provided by systems designed specially for this field called authoring systems. An authoring system is usually a development environment that creates applications. These applications are either interactive learning programs or multimedia databases.

The first requirement for an authoring system is ease of use. You should be able to use an authoring system even if you have no programming knowledge. You design the display and all actions are mouse-controlled and object-oriented. The result is an application that's easy to use.

A second requirement is that data such as text, graphics, photos, sounds, videos and animations can be assembled to run in a specified order. In the past you could have used presentation programs such as MMPLAY included with the Sound Blaster sound card for a presentation combining text, graphics, photos, sounds, videos and animations.

However, a true authoring system requires two additional items. The user of your presentation must be able to change the order of the presentation (branching) and be able to respond interactively with the presentation.

User access to interactive tutorial applications and multimedia databases is no longer entirely sequential (as in a book). Instead, cross-references are used to access all levels. This programming technique is called Hypertext. You can create hypertext with an authoring system. These systems are used to create interactive learning programs and multimedia databases.

Depending on structure, these two application types can overlap and become indistinguishable. An interactive tutorial learning program is usually attached to a database. So, by adding a few control commands, a database can become a learning program.

These basic requirements - ease of use, linking of multimedia data, branching and interactive response - can be implemented in many ways with several different programs. Often you can find an adequate solution in the packages that come with sound cards and CD-ROM drives. Other sometimes very sophisticated software can be purchased separately. We'll discuss **three** authoring systems in this section.

Microsoft Multimedia Development Kit (MDK)

The Microsoft Multimedia Development Kit is an add-on to the Microsoft Windows Software Development Kit (SDK) or the Borland C++ Compiler. By using this kit, you can develop multimedia titles and applications for Microsoft Windows graphical environment with Multimedia Extensions 1.0 or the Windows 3.1 operating system.

All the kit's contents are located on a CD-ROM disc. This development kit contains APIs (Application Programming Interfaces) which allows you to access the power of Windows' graphical environment with Multimedia Extensions. MDK also contains header files. These files are needed to use the Multimedia Extensions in Windows programs written in C.

The Microsoft Multimedia Development Kit also contains several development tools which you can use to prepare data. These tools include the following:

- Microsoft BitEdit for editing bitmap images
- Microsoft PalEdit for adjusting color palettes
- A sound editor called Microsoft WaveEdit
- Microsoft FileWalker for viewing and editing resource interchange file format (RIFF) and other data files
- A file format conversion utility called Microsoft Convert.
- An on-line Help system
- Sample applications and sample MIDI and waveform audio files.

The most impressive tool is the Multimedia Viewer, which is an authoring system. By using this program, you can create "content-rich" multimedia titles. An example of a title is an encyclopedia multimedia application. To create a Viewer document, you must use Microsoft Word for Windows.

To create a title, organize the text and bitmaps into topics. These topics are then linked into "books". To do this, you must specify "hotspots", which can be text strings or areas of bitmaps. These hotspots can also activate audio files or animations.

CD Complete: Put It In Action

The Microsoft Multimedia Development Kit can be used by C programmers and regular users who are using authoring tools to develop multimedia titles. The MDK is useful for C programmers because it provides the additional elements that are needed to write Multimedia Windows programs.

These tools also make it possible to add multimedia capability to existing Windows applications. For regular users, the MDK provides useful documentation on the Media Control Interface (MCI) and tools like Multimedia Viewer.

The Microsoft Multimedia Development Kit is divided into the following parts:

1. Multimedia Extensions

The Multimedia Extensions includes libraries, drivers and applications. These items make it possible for Windows 3.0 to support the multimedia features that are included with Windows 3.1. These features include support for waveform audio playback and recording, MIDI and joystick input.

2. Data Preparation Tools

The Data Preparation Tools are programs which you can use in preparing and editing sound and image files for multimedia applications.

3. BitEdit tool

Use the BitEdit tool to edit bitmapped graphics. With this tool, you can crop a bitmap, change the size or color depth or rotate selected areas in a bitmap. Use the PalEdit tool to create or edit color palettes for bitmaps or stand-alone palette files. For example, you can apply a new color palette to an existing bitmap.

4. WaveEdit tool

The WaveEdit tool can be used to edit and play waveform audio files. For example, you can cut and paste between waveforms and adjust sound characteristics. Use the FileWalker tool to view and edit various types of files. The Convert tool allows you to convert data files from one format to another.

5. Multimedia Viewer Author Toolkit

The Multimedia Viewer Author Toolkit is the multimedia authoring and presentation program. It lets users create and distribute on-line documents, called titles, that contain text, pictures, audio and animation and run in Windows. Multimedia Viewer titles can contain multimedia elements, such as text with various fonts, sizes and colors. Titles can be stored on magnetic (hard drive) or optical media (CD-ROM).

CD Complete: Put It In Action

The Multimedia Viewer Author Toolkit contains many elements:

- The Build Utilities build the Multimedia Viewer data files containing text, hypertext links and references to multimedia data.
- Hotspot Editor allows you to add hypertext hotspots to bitmaps.
- The Runtime Viewer displays Multimedia Viewer files.
- The USA Tour is a sample title demonstrating the Multimedia Viewer features. These source files should help you build your title.

Multimedia Development Environment

The final part of the Microsoft Multimedia Development Kit is the Multimedia Development Environment. This is a collection of programming libraries, source files and debugging tools.

The Multimedia Development Environment is required to develop applications for the Windows operating system. If your development platform uses Windows 3.0, install these tools from the MDK. If your development platform uses Windows 3.1, use the Windows 3.1 Software Development Kit (SDK).

The Multimedia Development Environment includes C header files and libraries, a debugging version of the multimedia extensions, and sample applications that demonstrate the multimedia extensions API. There are also on-line reference files that provide complete information about Multimedia Extensions functions, messages, commands and data structures.

Installing Microsoft Multimedia Development Kit

To install the data preparation tools, Multimedia extensions 1.0 (for Windows 3.0 only) and Multimedia Development Environment (on Windows 3.0 systems only), use the Setup program that's located in the root directory of the MDK CD-ROM.

First, insert the MDK CD-ROM in the CD-ROM drive. Change directories to the root directory of the MDK CD-ROM. At the DOS prompt, start the Setup program by typing:

```
SETUP
```

Then press Enter. The installation process begins. During this process, you'll be asked for the directory path for MDK files and whether you want to install the multimedia data preparation tools and sample multimedia data files.

You'll also be asked whether you want to install the Multimedia Development Environment (Windows 3.0 only) and the directory paths for the library and include files and the debugging and non-debugging versions of Multimedia extensions. Also, you must specify whether you want to install sample C programs.

Installing the Runtime Viewer, Build Utilities and USA Tour

To install the Runtime Viewer, Build Utilities and USA Tour, use the Setup program in the \VIEWER directory of the MDK CD-ROM. First insert the CD-ROM in the CD-ROM drive. Since you must start the Setup program from Windows, make the Program Manager the active application.

Choose **Run** from the **File** menu. Then type the letter of CD-ROM drive, followed by:

```
\VIEWER\SETUP
```

Then select OK. During this installation process you'll be asked for the directory path from Multimedia Viewer files and whether you want to install the sample files used to build the USA Tour title.

Multimedia titles

Basically, you can use the MDK to create multimedia applications. These applications consists of titles. As we mentioned earlier, a title is an on-line document. This means that a title is an electronic document that exists on a computer screen.

There are various kinds of titles. The type of titles you use depends on the purpose of the multimedia application you want to create.

Titles can be divided into five categories:

Productivity titles	Productivity titles enhance productivity applications, such as spreadsheets and databases.
Information titles	Information titles are usually reference materials, such as dictionaries and encyclopedias.
Entertainment titles	Entertainment titles are used to create games and other leisure multimedia applications.
Creativity titles	Creativity titles help users increase their creativity by providing the appropriate tools, such as sound and images. With these tools, you can create interesting presentations for business or personal use.
Education titles	Finally, there are education titles. These titles enhance educational applications by making them interactive and including references to related topics.

Chapter 3

CD Complete: Put It In Action

Multimedia Viewer's Basic Components

In this section we'll briefly discuss the elements found in the Multimedia Viewer user interface.

The various units of information found in a title are called "topics". All related information is placed together in one topic. The first topic that appears when a title is opened is the Contents topic. All the topics contained in a title can be accessed from this topic.

Another element of Viewer is "jumps". These are cross-references to related topics. Certain text and pictures can be specified as "hotspots". When these hotspots are activated (i.e., clicked on), Viewer displays the related topic.

Popup windows

Popup windows are used to provide additional information about a term or explanation. You can associate definitions and other information with specific terms in a topic. When these terms, which are also hotspots, are clicked, the appropriate popup window appears on the screen.

Viewer menus

The Viewer has four menus, which appear in every Viewer window. Use the commands in the **File** menu to display titles, print topics, specify printer information and exit the Viewer. With the commands in the **Edit** menu, you can copy text and add text to a topic. The **Bookmark** menu allows you to define bookmarks that are placed in titles. Use the commands in the **Help** menu to access on-line Help.

The final element in the Viewer interface is the Viewer buttons. These buttons are located below the menu bar in the Viewer window. Use these buttons to access topics in a title.

MacroMedia Action!

MacroMedia Action! is an authoring system which lets you create multimedia presentations combining sound, motion, text, and graphics. You can also include interactive elements in your presentations. These elements let the user determine the course of the presentation by clicking certain buttons on the screen.

Action! is different from many other multimedia programs because it uses shapes, graphics, and text that move around the screen instead of staying in one place. You can also add sound to these moving images.

Installing Action!

To install Action! on your hard drive, use the Install program that's located on Disk 1. Insert this diskette in your disk drive and then start Windows. Choose **File/Run....** in the Program Manager and type the following:

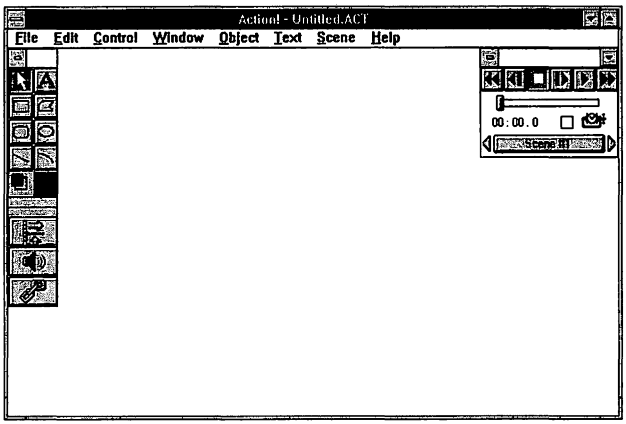
```
A:Install
```

and press Enter.

Complete the installation process by following the instructions that appear on the screen.

Starting Action!

Once Action! is installed, an icon representing the program appears in the Windows Program Manager. To start Action!, double-click this icon. When you do this, an empty presentation window appears:



Presentation window

The top line of the window is the title bar, which displays the name of the current presentation. The line below this is the menu bar. The Tool Palette is used to create objects and apply motion, sound, and linking. To determine where you are in the presentation, use the Control Panel. The stage is the part of the window where presentations are played.

Elements of Action!

Action! presentations consist of scenes. Each scene contains objects. These tools are either drawn with the tools from the Tool Palette, imported from other applications, or imported from ClipMedia, which is included with Action!.

Besides the tools that are normally included with drawing programs, Action! also provides tools for adding motion (action tool), sound (sound tool), and interactivity (link tool) to your presentations.

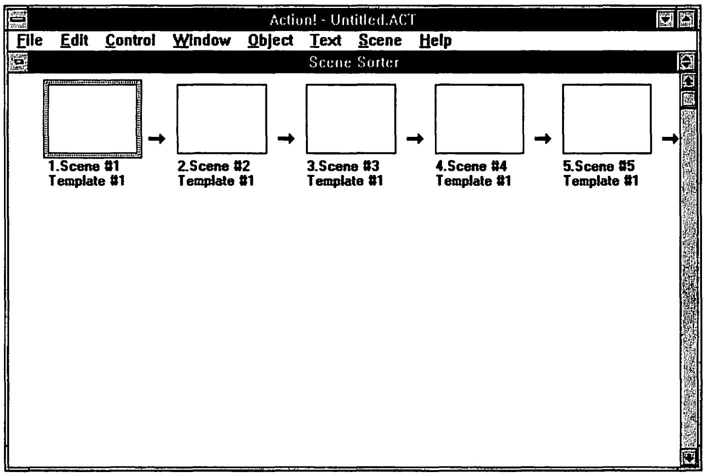
As objects are created in a scene, they appear in the Timeline and the presentation window. The Timeline is a window that shows how long an object is and where it's located in the scene, in relation to the other objects.

The Content List displays a list of all the scenes in the presentation and all the objects in each scene. This provides an overview of your presentation; it also helps you edit text objects in a scene.

The Scene Sorter displays an image of each scene in the presentation, the scene's name, and its associated template. It also shows what happens at the end of the scene and any sound that plays between scenes.

Action!'s Views

Action! has several views, or windows, in which you can work. Usually the Scene view is used.

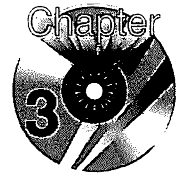


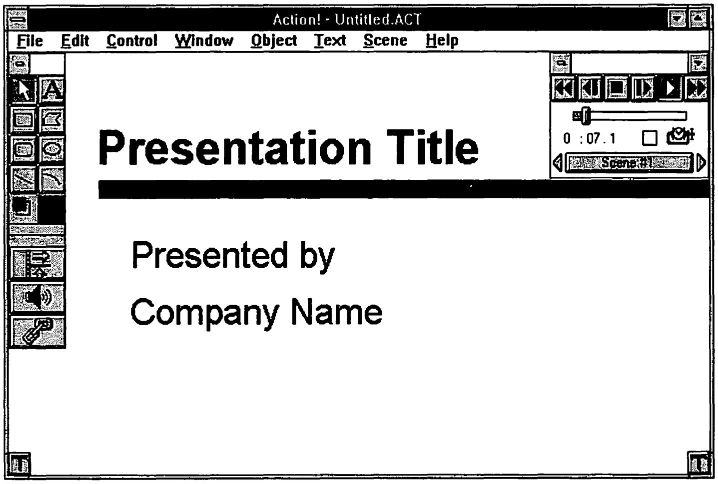
Scene view

In this view, the objects are displayed as they occur at a specific scene time. At a certain scene time, some objects are in transition and some have the stage or haven't appeared yet.

Use the Template view when you're creating and editing a template. A set of templates is included with Action!; these are ready-to-use scenes that contain objects, motion, transitions, and text. These templates can be edited by changing the text and graphics so they can be used in your own presentations.

CD Complete: Put It In Action





Template view

Compressed view is used when you open an existing Action! presentation. In this view, all scene and template objects are displayed in their Hold positions. This helps you align objects, change positions, and re-size objects.

Creating multimedia presentations

The following is a brief overview of the steps involved in creating an Action! presentation. We don't have enough space in this book to discuss these steps in detail. However, simply remember there are three basic steps:

- Creating objects
- Creating scenes
- Creating presentations

There are several things you must do before you actually work with Action!. First you must determine what the presentation will be about and how long it will be. Once this is done, create an outline for the presentation. Based on this outline, divide the presentation into scenes. Next check the Action! Template Guide for a template you could use for your presentation. Also, collect the graphics and sounds you'll need.

Now you're ready to use Action!. First load or create a template if you want to use the same objects in several scenes. Then, in the presentation window, draw objects or import objects using the Tool Palette.

If you want to add motion, sound, or interactivity to your objects, use the appropriate tools. When you're finished, check the results by playing the scene with the buttons on the Control Panel. Synchronize the objects in scenes by using the Timeline and use the Content List and Scene Sorter to edit and rearrange scenes.

When your presentation is complete, play it on your monitor or print it to videotape.

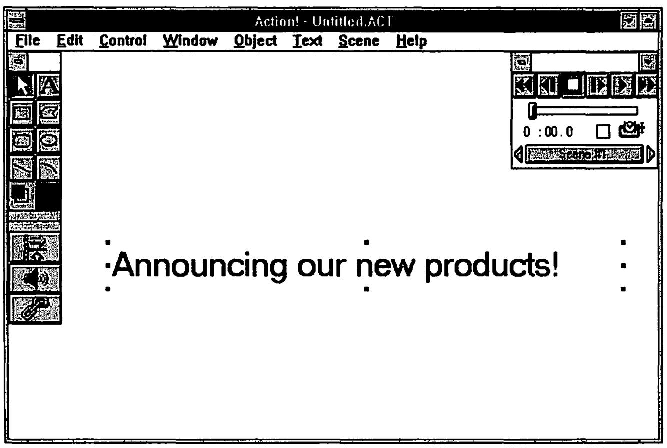
Now we'll use a brief example so you can become familiar with Action!. Obviously, we don't have enough space in this book to discuss this program in detail.

Creating objects

As we mentioned, once you determine the type of presentation you want to create and then develop a plan, you can begin by creating objects.

With the Tool Palette, you can create text objects or graphics objects, such as rectangles and arcs. Let's create a text object. In the presentation window, click the Text tool in the Tool Palette. The mouse pointer changes to a text cursor. In the stage area of the presentation window, click where you want the text to begin. Since we want to create a box, drag the mouse to create a box in which the text will appear. Now type the following:

```
Announcing our new products!
```



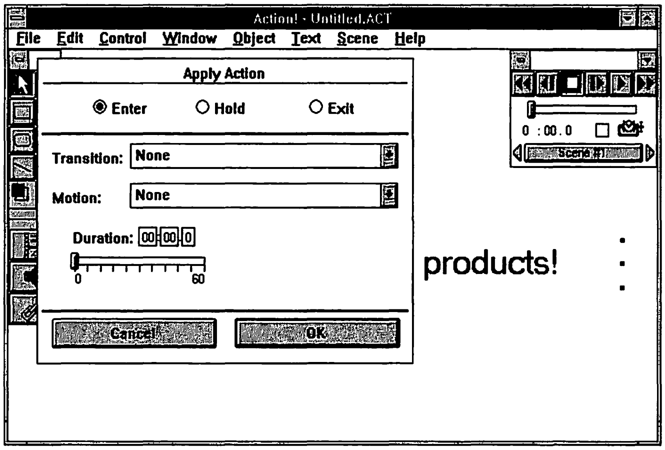
Creating a box

Then click outside of the box. You'll see that the cursor changes back to a pointer and the text box is selected.

Now that we've created an object, we can apply actions to it. This adds excitement because the object isn't displayed in just one static scene.

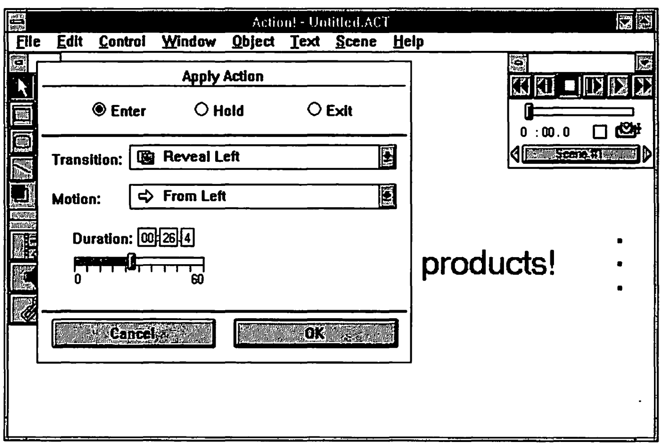
CD Complete: Put It In Action

In this step, we'll determine how our box appears in the scene and how it's moved while in the scene. First click the Action! tool in the Tool Palette. Then move to the presentation window. You'll see that the pointer changes into the Action! cursor. Click the box you just created.



Apply Action! dialog box

Now click on the "Enter" option button and select "Reveal Left" from the "Transition:" drop-down list box. This specifies how the box enters the scene. Then select a motion for the box's entrance. Select "From Left" from the "Motion:" drop-down list box.

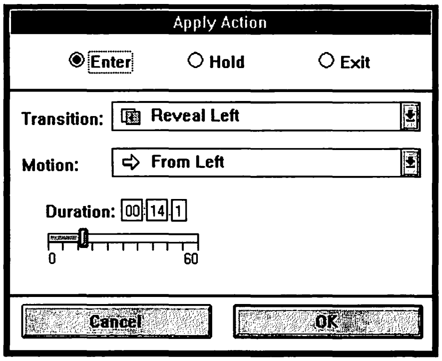


Selecting a motion

Next we must select a transition and motion for Exit. To do this, click on the "Exit" option button and select "Push Left" from the "Transition:" drop-down list box. Then select "To Lower Left" from the "Motion:" drop-down list box.

CD Complete: Put It In Action

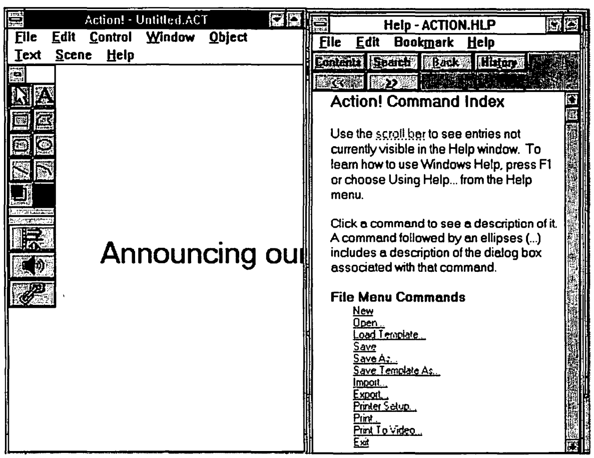
Once you've selected a transition and motion for Enter and Exit, you must determine how long these actions will occur. In our example, we'll use a two second duration for both Enter and Exit. Enter this time in the "Duration:" text box either by using the boxes, using the slider, or clicking the arrows. You'll need to click on each option button ("Enter" and "Exit"), then set the duration for each.



Setting the duration

Each object has a default duration of 10 seconds. The object stays in its Hold position for this amount of time. The time you set for Enter and Exit is added to this value. So, in our example, the duration is 14 seconds.

Action! provides ways for including sounds, animation, and images in your multimedia presentations. It's quite powerful and has an extensive array of commands and functions. You might prefer to show the Action! Help system while you are working, as the following illustration shows.



Each Action! scene consists of objects, such as text, graphics, sounds and animation clips.

Multimedia database

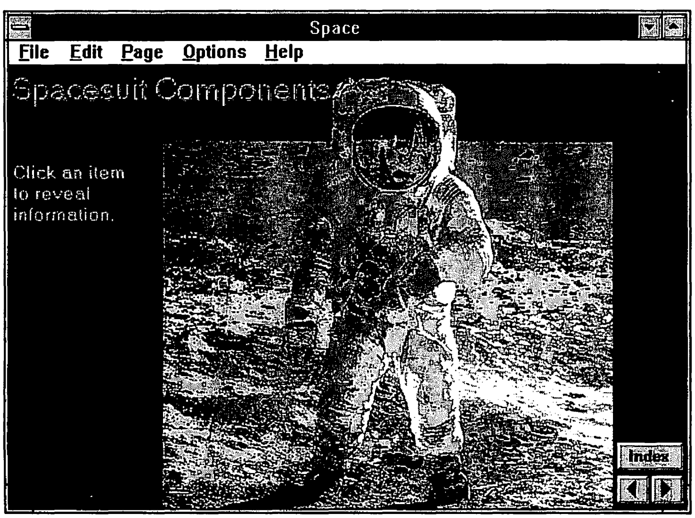
Although fewer demands are placed on a multimedia database than on an interactive tutorial program, the user must be able to access the desired information quickly. Also, supporting information must be available through cross-references. Animations, video sequences and sound files enhance multimedia database capabilities beyond conventional printed sources like encyclopedias. Although these sources also contain cross-references, you must look them up manually.

A path through a multimedia database may lead to many levels. Each level has additional cross-references. For example, if a person is mentioned in an explanation of a topic, additional information about this person can be accessed with a mouse click. Then, when a button is pressed, the person's voice can be played from the speaker.

After retrieving the information, you can return to the original topic and continue from there. With the Hypertext technique, the pages of information appear to be on a stack on top of each other. When a page is selected, it moves to the top. Usually there is a complex network of other, equivalent, levels.

Using point and click for selecting topics is another unique feature. For example, if a map is displayed, information about mountains, cities, etc. can be accessed by clicking on the appropriate positions in the map.

In the following illustration, from the Space demo program included with ToolBook from Asymetrix, you would click on the space suit to learn more about its components.



Space travel using a ToolBook application

CD Complete: Put It In Action

When you're creating a multimedia database, first you must determine what terms or information will be on the main level. Then you must determine what secondary information will be included for each term.

An excellent example of this is the structure used by HyperGuide, the multimedia help system component of the Multimedia Extension for Windows 3.0. Windows 3.1 users will not have this example, but may follow the description in the following section.

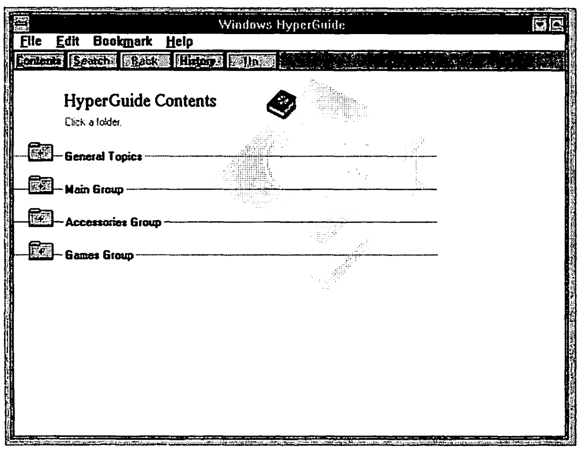
If you're using Windows 3.1 and have the Microsoft Multimedia Development Kit, you may examine HyperGuide by opening Help. Then select **File/Open...** and change to the CD-ROM directory which contains the CD-ROM for the Microsoft Multimedia Development Kit.

Then change to the HYPER directory and select HGCD.HLP. The next section describes the results and subsequent options available after opening this file.

Using HyperGuide

The information in a multimedia database is usually available on a CD. Program software is installed on the hard drive for speed and configuration reasons.

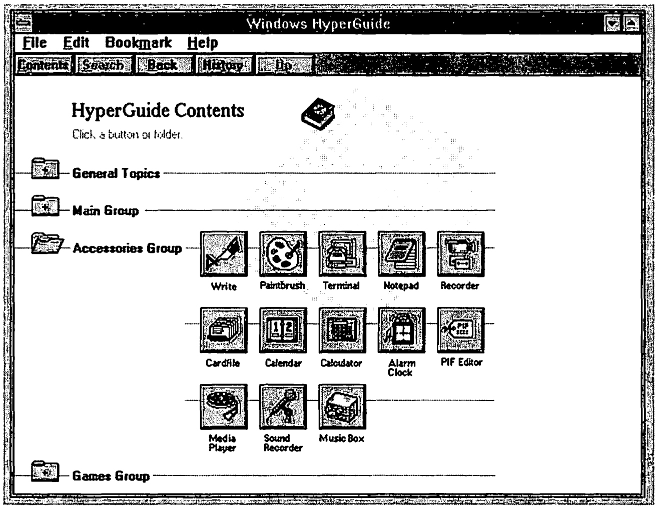
As you can see in the following illustration, HyperGuide includes four main groups. If you click an icon for a group, a list of additional topics appears.



The HyperGuide screen

To display a topic, click on its label or icon. The changed appearance of the mouse pointer indicates the action that can be performed.

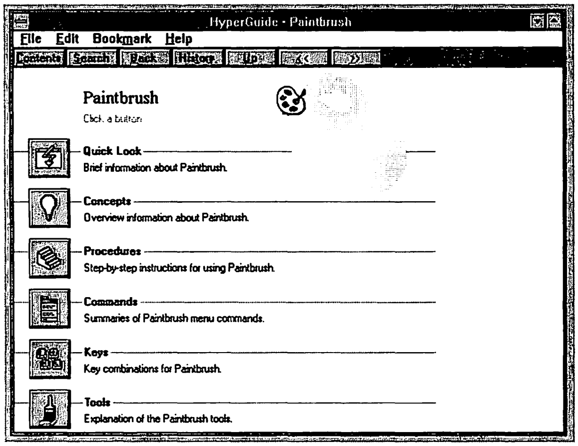
When the mouse pointer has changed, for example, into a hand, you can click on an area underneath the mouse pointer and activate it. If you click on Accessories Group, a selection menu appears in which additional themes are displayed as icons.



Sub-topics are displayed as icons

To move to another level of the selected topic, click on an icon. Another window lists additional possibilities related to the topic. Choose the method used to display the information:

Type	Function
Quick Look	Short, keyword-oriented examination
Concept	Basic work methods
Procedures	Step-by-step explanation of use
Commands	List of all commands and functions
Keys	List of keyboard functions
Tools	Explanations of individual components



Various topics

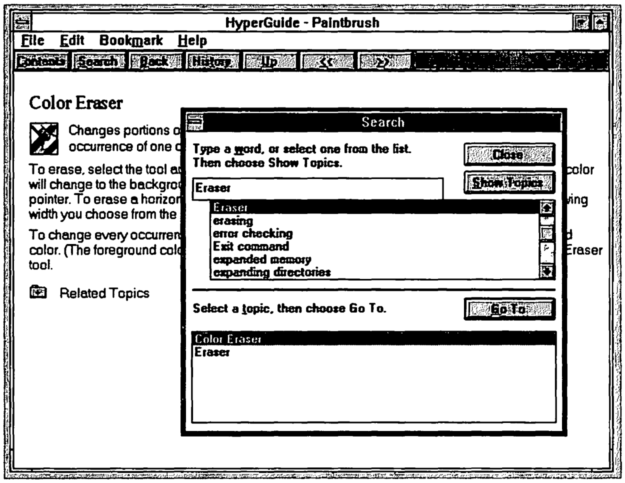
Selections until now were based on a search for specific information. By continuing in this way (step-by-step in HyperGuide), you'll eventually, awkwardly, reach the appropriate topic. This occurs when looking for the solution to a specific problem.

We'll use a Paintbrush example to explain this. To learn the procedures for Color eraser (in HyperGuide it's called Color Eraser), the following steps are necessary:

- Choose Accessories Group
- Choose Paintbrush
- Choose Tools
- Choose Erase

By using the icons for Paintbrush and Eraser, even a beginner can quickly reach the desired page. An index search is faster, because the path to the desired information is usually more direct. Use Search to activate a dialog box in which you can enter the search word.

There are several ways to access the search word from there. One helpful function is a corresponding list display after each input letter. For example, when you enter an "E", the entries beginning with "E" are placed at the beginning of the display. If you type the next letter of the search word, a more detailed search begins.



Searching for information

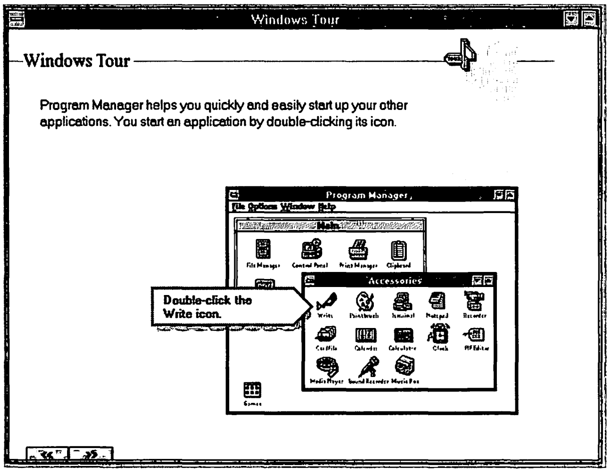
Successful searches for a topic

If you know the exact label for the function, enter it in the input field. The term will be marked in the list field.

In the Color Eraser example, you could also search for the term "Eraser". This entry is sufficient since the index search provides both the normal Eraser and the Color Eraser for selection.

Related information can be connected with cross-references. You can use cross-references to access different levels:

Related topics	These topics are displayed in green and underlined. When you click this kind of cross-reference, the related topic is displayed.
Definitions	After being activated, definitions or explanations for certain key words are displayed in a small window. This type of information is displayed in green letters and underlined with a dotted line.
Graphic cross-references	In this case, the cross-reference appears as a graphic icon. True Hypertext applications can include cross-references to additional information in the graphic.



Areas in graphics can be activated

A HyperGuide window contains several control buttons. By pressing them, you can move between individual pages.

Contents	This button leads to the HyperGuide main menu, regardless of your current location.
Search	This button opens a dialog box for an index search. When an entry in the topic list is selected, the appropriate topic entry is displayed.
Back	This button displays the previous page. The order of pages depends on the entries in History.
History	This button lists all the topics that have been called since HyperGuide was started. By using this feature, you can repeat a topic quickly, without going through the cross-references again.

If you want to mark a specific page for later reference, use **Bookmark/Define...**. An entry is made in the **Bookmark** menu. You can select it at any time to access the appropriate page.

Inserting Your Own Comments In Help Texts

The HyperGuide window contains brief and precise explanations of many topics pertaining to Windows. The entire system is based on an extensive collection of help texts, which are located on the Multimedia Extension CD.

Select **File/Open...** to load the normal help files available for Windows applications. Help files have the file extension .HLP.

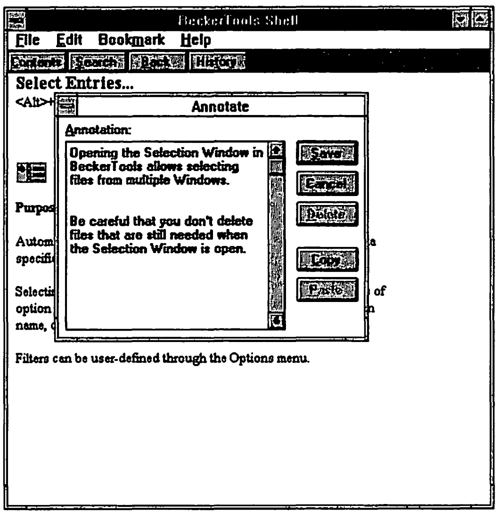
CD Complete: Put It In Action

These help files aren't text files. So, they cannot be read by normal text editors. However, it's possible that an explanation is incomplete or didn't include all the information you need.

Perhaps you want to add a few tricks or shortcuts you've discovered that may help other users. This can be helpful if many users have network access to HyperGuide.

Each topic can include an "Annotation" (comment) that's inserted into the help text. These annotations aren't inserted randomly on the page. Instead, they are stored on their own level.

A paper clip symbol appears in front of a topic header that has an annotation. The paper clip is treated like an underlined term and can be opened by clicking on it with the mouse.



Comments in the help text

A comment can be assigned only to a topic heading. To create an annotation, choose the page that will contain the comment. Select **Edit/Annotate...** to activate a dialog box, in which you can enter any text. Press Save to save it to the hard drive (since you cannot save to a CD).

Removing annotations

Each page can contain only one annotation. To erase a comment, choose **Edit/Annotate...** again and press Del. The paper clip and the annotation disappear.

CD Complete: Put It In Action

CD-ROM And Games

CD-ROM games have virtually exploded on the market. The shelves in software and game stores are practically overflowing. Even video stores are renting games on CD-ROM for one or more nights.

Games created for the PC have improved much in quality over the years. In the beginning, users had to type in the BASIC game programs themselves. This was followed by loading games directly from diskette (or even cassette). More recent advancements include installing games on your hard disk. In the last few months, the newest medium, CD-ROM, has successfully broken through the hard disk size barrier.

Initially CD-ROM games contained high-quality graphics and full sound capability. An example is Wing Commander from Origin. An early hard disk version of Wing Commander required about 20 Meg of hard disk space. Many customers were unable to use later versions of Wing Commander because it exceeded the available capacity of their hard disk drive. So, Wing Commander was one of the first games to be fully available on CD-ROM (Wing Commander 1 and 2 plus Speech Disc plus Mission Discs).

Since CD-ROM software was not widely available in stores early on, several CD-ROM versions of this game soon appeared. One version was a simplified version, another the complete game and another combined with other different games . In this way, customers were under the impression that a large amount of software was being manufacturered for CD-ROM drives.

Even today, it's still rare for a computer game to be published or produced exclusively for CD-ROM.

Normally, a publisher first releases a diskette version of a game. When the publisher also decides to produce a CD-ROM version, this usually involves simply transferring the diskette version to the CD-ROM without enhancing or changing the game.

Therefore, the potential for better sound and graphics on the CD-ROM is often overlooked. Another criticism is that although software producers would gladly use the CD-ROM as the superior and more modern storage medium, the software offered still lags behind its advanced capabilities.

Only since the appearance of games with true video-play, such as Rebel Assault, have we noticed that CD-ROM as a data medium for games is becoming accepted not only by PC users but by the software producers as well. CD-ROM should now fit in neatly with the plans of many game manufacturers. First, the cost of manufacturing a CD-ROM has decreased to the point where it is very comparable in cost to duplicating diskettes. Second, it's more difficult to produce pirated copies of CD-ROM software.

Most games on CD-ROM require a limited installation on the hard drive (in addition to the CD-ROM data). In any case, the system configuration must be stored somewhere. For example, game scores can only be stored on the hard drive. The data for sound, graphics and video-mode are almost always read in directly from the CD. Meanwhile the amount of data stored on the CD-ROM is such that any hard disk under 1 gigabyte would be unable to store more than 1 or 2 games.

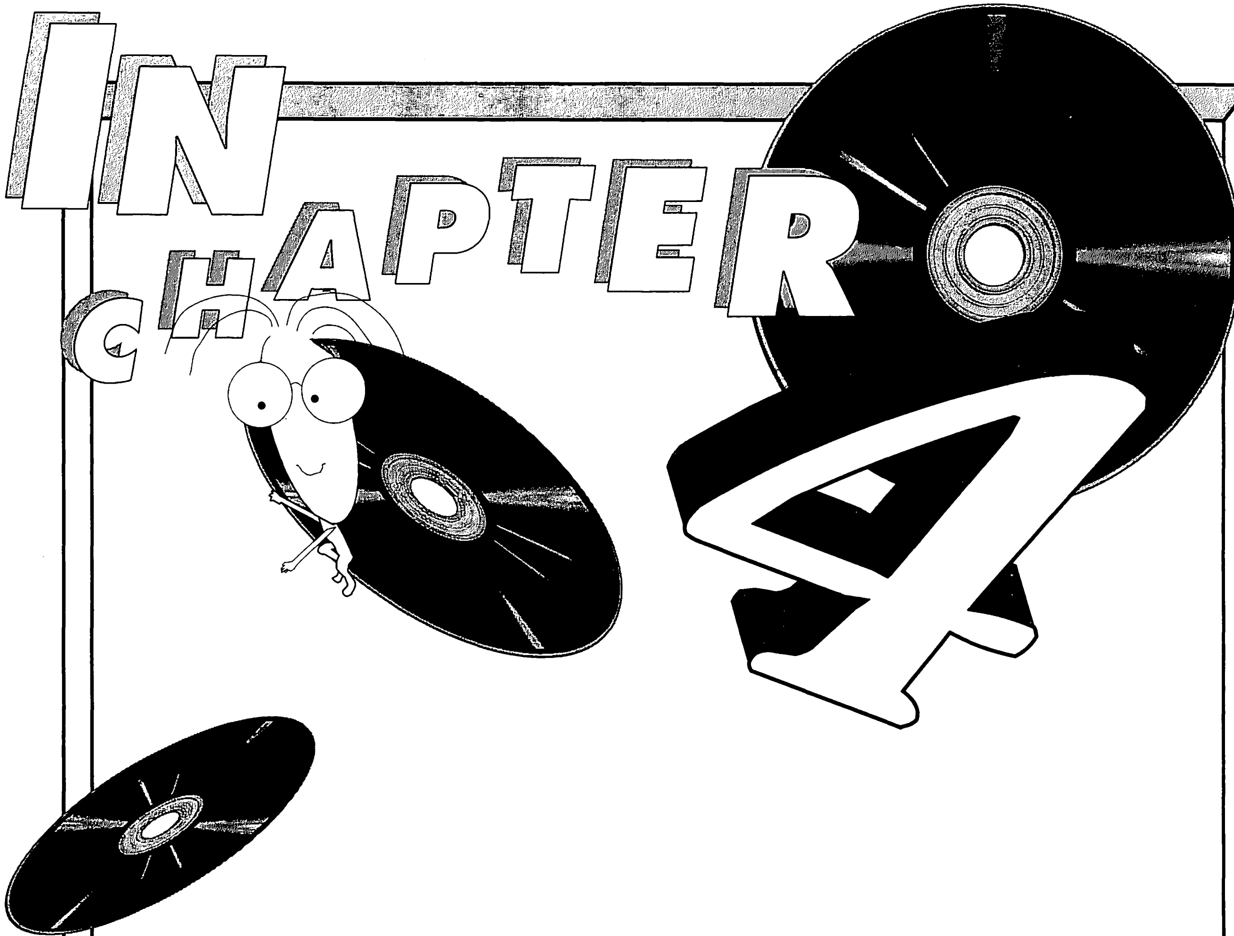
So where are PC games headed? Until now, diskette based games usually included large manuals and instructions. In other words, publishers didn't want to put just a diskette in a package, they also tried to provide entertaining pictures and reference material. This way buyers not only had a game program to amuse themselves on-line, they could also keep busy leafing through the manuals.

The newer CD-ROM games on the other hand, to the extent that they differ from existing diskette versions, not only include the nucleus of the program - the playable software - but are enhanced by sound and animation. In fact, playing film scenes, continuous graphics, hi-fi quality sound are the hallmarks of the next generation of PC games.

Maybe this is why the size of the instruction manuals has actually decreased. This is mainly because running game programs has become so easy very often all you need are a few mouse clicks. Clearly CD-ROM has become an important source of entertainment, not just through games, but through multimedia collages of all types.

CHAPTER 4

What You Need To Know

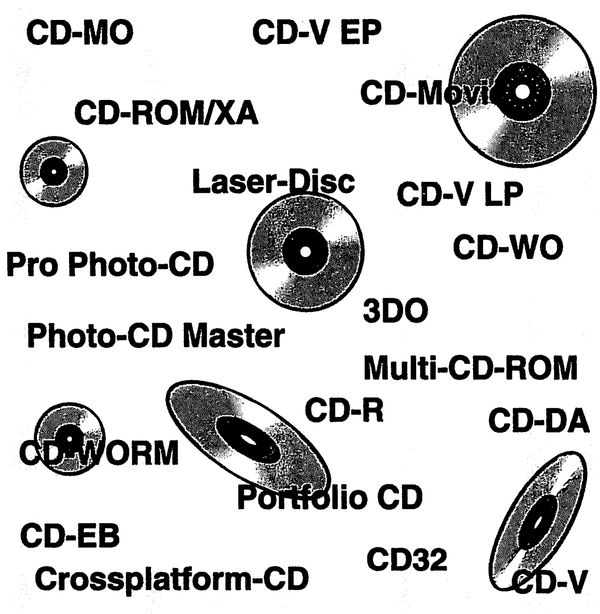

IN
CHAPTER
4

4 What You Need To Know

It's easy to become confused in the world of CDs.

Not only are there are a variety of formats from which to choose, you'll also find different names, acronyms, capacities, variations, sizes, and much more.

It's no wonder we might be confused. Just take a look:



In this chapter we'll try to explain these various formats so you'll better understand the terminology used with CD-ROMs. We'll describe the important standards that are established for CDs; how data is recorded on them and how errors are caught and corrected. We'll even show you how CDs are manufactured.

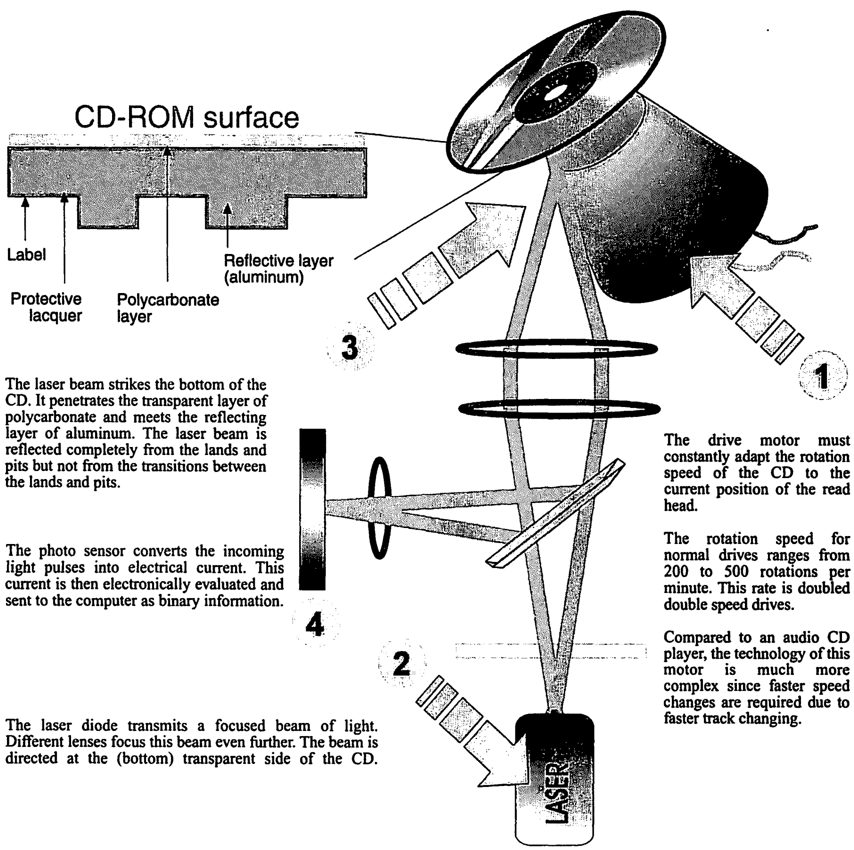
Chapter 4

What You Need To Know

Technology And The CD-ROM Drive

Before we describe the different CD-ROM formats and standards, let's take a look at the technology behind the CD-ROM drive. This is summarized in the following illustration:

CD technology



CD-ROM Drives and CD Players

They may look the same on the outside, but a CD-ROM drive is quite different on the inside than an audio CD player.

What You Need To Know

The purpose of a CD-ROM drive is to deliver error-free information to the computer. With this in mind, the CD-ROM drive components are higher quality and more rugged than those in an audio player. In particular, the electronic are more complex and exacting. They perform a critical role in detecting and correcting read errors that are inherent in processing huge volumes are information that a CD-ROM disc holds.

The Red Book specifies the error detection and correction procedures for the audio CD. For CD-ROM drives, the Yellow book spells out a more stringent mechanism integrated into the hardware for identifying and correcting errors. The purpose of the additional hardware, of course, is to ensure that the computer information is presented without errors and with minimum impact on processing speed.

The rotation speed of both the audio CD player and the CD-ROM drive are variable. On a disc, the inner tracks are shorter than the outer tracks. To read a fixed amount of data in a given time period, the drive needs to maintain a constant linear velocity (CLV) over the data. To do this, the speed of the spindle motor is varied. The motor turns slower when reading information close to the inner edge (containing shorter tracks) and turns faster to read data near the outer edge. These speed changes occur much more frequently and rapidly with CD-ROM drives subjecting the spindle motor to much more use than audio CD player motors.

The laser mechanism in a CD-ROM drive is also subject to more use. When playing music on an audio CD, the laser head moves predictably from the inner to the outer edge of the disc. Reading data from a CD-ROM isn't as predictable and so the laser head undergoes frequent and fast repositioning.

Some CD-ROM drives use caddies to protect the CD-ROM disc. For these types of drives, an additional loading mechanism is used that isn't required by audio players.

Representing Data

For those of you who aren't familiar with the way in which computer data is represented and stored, we'll take a short time to explain the concepts.

The smallest unit of information that a PC can read is called a *bit* (binary digit). A bit consists of the values 0 or 1, off or on. Since we can only assign two different values to a bit, we're limited in the amount of information that a bit can represent.

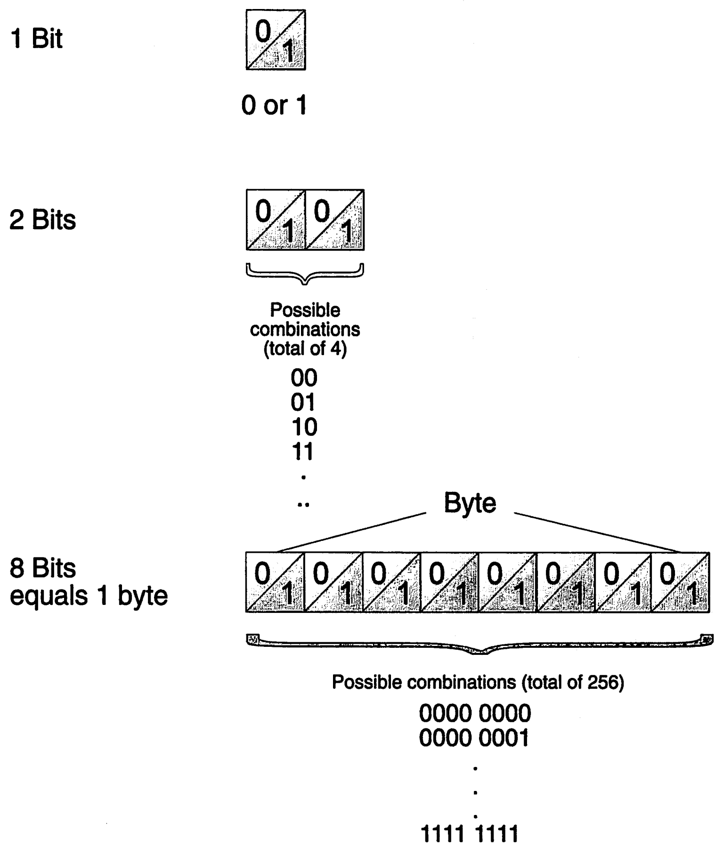
We can only differentiate between more than two conditions by considering several bits together. By combining two bits for example, we can represent four different values: 00, 01, 10 and 11.

Similarly, by combining eight bits, we can represent 256 values. In other words, there are a total of 256 different ways to combine a series of 0's and 1's using eight bits. The eight bits, also known as a byte, is a more convenient way to represent data.

How do we represent text? To do this, we can choose a unique combination of bits for each letter of the alphabet. So we need 26 different combinations for the upper case letters A, B, C, ... Z. To represent a, b, c, ... z, we use an additional 26 combinations and another 10 for the numerals 0, 1, 2, ..., 9.

These bit combinations have been standardized as ASCII code (for American Standard Code for Information Interchange) and are widely used to represent text on all media including CD-ROM discs.

The units of information



Channel bits

The smallest unit of information on a CD disc is also a bit. Since all the data on a disc is represented in a single continuous track, you might think of it as a data *channel*. On a CD, these bits are referred to as "channel bits". Let's see how the data is stored on a disc.

Earlier we said that data on a CD disc is represented by *lands* and *pits*. A land is the normal, flat surface of the disc. A pit is a depression in the surface of the disc.

The transition from a land to a pit or the transition from a pit to a land is used to represent binary 1. Land and pits are used to represent binary 0. The length of a land or the length of a pit determines how many binary 0's are represented.

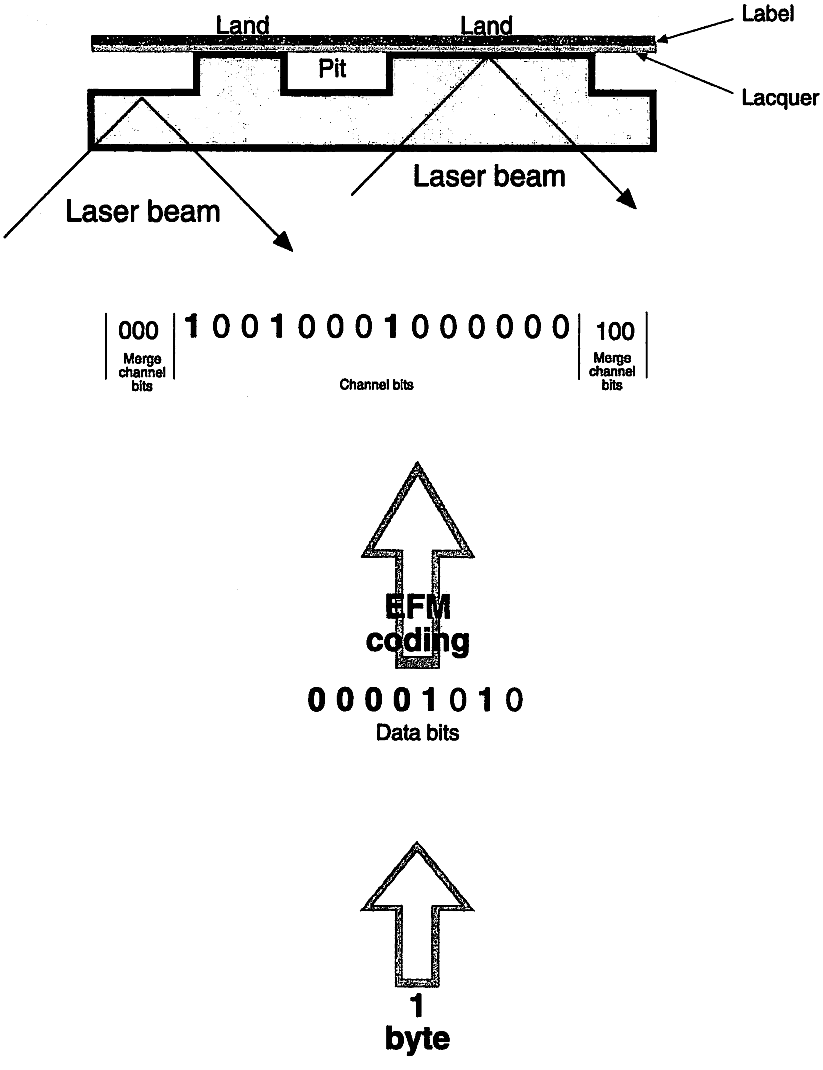
Due to technical limitations, the minimum length of either a land or a pit is 3 bits; the maximum length is 11 bits. From this you can see there's a problem trying to represent two consecutive 1 bits when the technical limitations requires no less than two, nor no more than 10 binary 0's between transitions.

Using this scheme, not all combinations of 0 and 1 are permissible. The conclusion: eight bits are not sufficient to represent all 256 combinations of a byte.

A new 14 bit scheme is used instead. Each 8-bit combination is converted to a 14-bit equivalent channel byte using a lookup table. With 14 bits, we stay within the technical limitations which require at least two binary 0's between transitions.

The following shows how the data is converted to channel bit format.

Coding information on the CD



Converting between 8-bit and 14-bit combinations is called eight-to-fourteen modulation (EFM) or *scrambling*.

Here's part of the EFM conversion table:

EFM Coding	Channel Bits	Data Bits
0	01 001 000 100 000	0000 0000
1	10 000 100 000 000	0000 0001
2	10 010 000 100 000	0000 0010
3	10 001 000 100 000	0000 0011
4	01 000 100 000 000	0000 0100
5	00 000 100 010 000	0000 0101
6	00 010 000 100 000	0000 0110
7	00 100 100 000 000	0000 0111
8	01 001 001 000 000	0000 1000
9	10 000 001 000 000	0000 1001
10	10 010 001 000 000	0000 1010
11	...	...

So we've found a way to defeat this slight technical problem.

Before rejoicing, there's one additional problem. How do we handle two consecutive 14-bit channel bytes, one which ends with binary 1 and a second which starts with binary 1?

The answer is to introduce "merge bits". Merge bits are a set of three bits which are inserted between each 14-bit channel bytes. Adding these extra bits solves the problem of recording two consecutive bytes with adjacent binary 1 bits.

Frames

Thus far, we've managed to take an eight-bit data byte and represent it as 17 channel bits. But we're not done yet. Jumping ahead a little, we'll introduce another term.

A CD-ROM drive reads a collection of channel bits as a *frame*. A frame consists of the following:

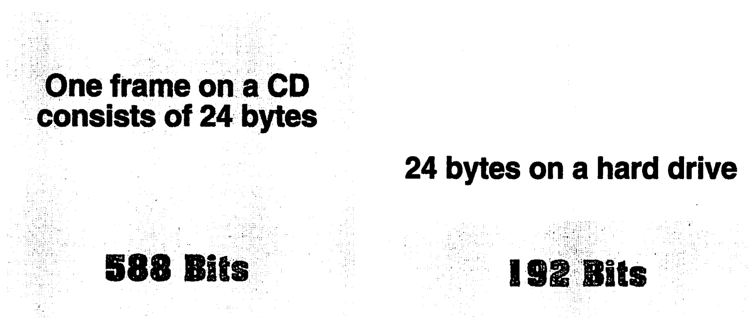
What You Need To Know

No. of bits	Purpose
27	Synchronizing the laser
17	Subcode byte (1 byte of 17-bits)
136	Error detection and error correction (8 bytes of 17-bits each)
408	Usable data area (24 bytes of 17-bit data bytes)
588	Total bits

We see in the table above, the 17-bit data bytes account for only part of the data that is recorded on the disc (408 bits). In addition, there are 180 other bits of information in each frame.

By comparison, a hard drive uses only 192 bits (24 bytes X 8-bits) to represent this same amount of data.

Bits and bytes



A sector consists of 98 consecutive frames. Combining these 98 frames, we see that a sector has the following attributes:

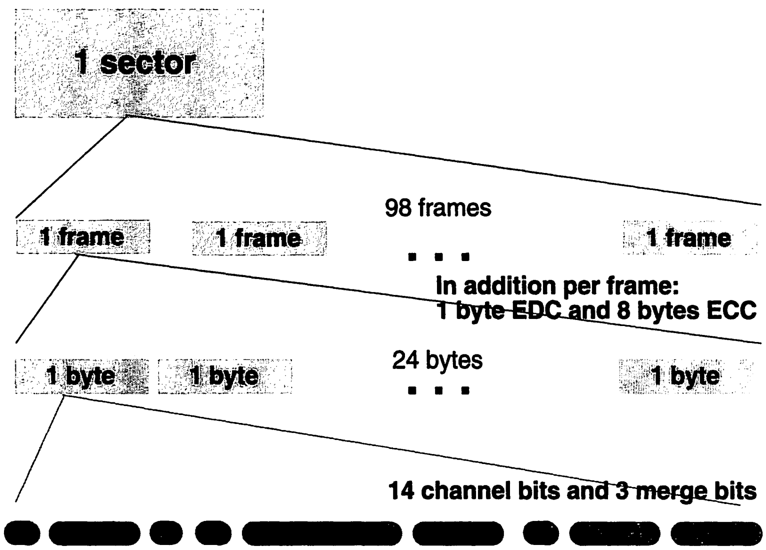
1 byte/frame	x	98 frames/sector	=	98 bytes for control information
24 bytes/frame	x	98 frames/sector	=	2,352 bytes for usable data area
8 bytes/frame	x	98 frames/sector	=	784 bytes for error detection and error correction
				3,234 bytes total per sector

As you can see, we can store 2,352 bytes of usable data (98 frames containing 24 bytes of data). Of the 2,352 bytes, 12 are used for synchronization to identify the sector and 4 are used for the header to identify the address and mode. This leaves 2,336 bytes for user data.

Audio CD's use the entire 2,336 bytes. However, CD-ROMs use 288 of these bytes for additional error correction code (ECC - Error Correction Code) leaving 2,048 bytes for user data.

The following shows how the data is organized within a sector:

Sector data organization



The following shows how the basic layout of a sector on the CD disc:

Sector layout on CD disc

The subchannels

Above, we saw that each frame contains a byte containing control information. This is called the control or subcode byte. Taken together from all the frames is a sector, these are a total of 98 subcode bytes.

The individual bits of each subcode byte are identifed by the letters P through W. The first bit is named P, the second Q, and so on. A subchannel results by associating all bits in the same position of subcode bytes in successive frames. The data stream consisting of the first bits of the 98 subcode bytes in a sector is called the P-channel. The sequence of data made up on the second bits is called the Q-channel. The six bits R through W are combined to make a single R-through-W subchannel.

The first subchannel, the P-channel, serves as a flag. It indicates whether music or computer data is found in a sector.

The Q-channel contains timing information. This may be either the absolute time measured from the start of the CD (ATime) or the relative track time measured from the start of the track (RTime). In the lead-in areas of the disc, 72 bits of the Q-channel contain the Table of Contents (TOC), while the remaining 26 bits are used for synchronization and error correction. The R-through-W channel contains data for synchronization and error correction.

Error detection and correction

The method used to recognize and correct errors encountered as the CD disc is read is a very reliable one. It's based on a process called CIRC (for Cross Interleaved Reed-Solomon Code) and is specified by the Red Book. Using CIRC, many errors can be detected and corrected using the electronic components integrated into both audio players and CD-ROM drives. The 784 bytes identifed as EDC/ECC are used for this purpose.

The results of the process are very remarkable. Theoretically, CIRC can reconstruct about 4,000 consecutive bad or missing bits. This yields a statistical probability of error of 10^{-8}. This is equivalent to a one byte error for each 10^8 bytes read. 10^8 is a large number; in fact it's about 100 Meg Using this scheme, a 600 Meg audio CD will have about six read errors. This is a tolerable level for audio where an error may cause a glitch in the music, for example.

On the other hand, six read errors is far too many on a 600 Meg CD-ROM disc, where the loss of data integrity can cause a program to crash or an application to produce disastrous results. So the error correction scheme for CD-ROMs is even more stringent as we'll see shortly.

Audio CDs

The basic technology for reading data using lasers was introduced in the early 1970s when Philips demonstrated the LaserVision video disk. The breakthrough in the use of the CD medium came with the release of the audio CD, which then led the way for the computer CD-ROM, a few years later.

CD Technical Data

The CD-ROM disc consists of a plastic polycarbonate material. Information is stored on only one side. A disc is 1.2 mm thick. Although the disc usually has a diameter of about 4.75-inches (12 cm), the newer single-play CDs or CD-EBs are only 3-inches (8 cm) in diameter.

Reading a disc uses a process that relies on constant linear velocity (CLV) - the laser read head scans the surface at a constant speed. The speed of rotation varies between 200 and 500 rotations per minute.

Changing the rotation speed continuously leads to relatively long access times, but it's expected that these times will decrease as the technology advances. An access time of 200 ms is common in high quality drives.

The density of the tracks on a disc is very high. Track width from midpoint to midpoint is 1.6 microns. Therefore, there are more than 16,000 tracks per inch. Pits are 0.6 microns wide and 0.833 to 3.56 microns long.

A disc has at least three areas in which data is written. One is the lead-in area and contains the table of contents (TOC). It occupies the inner 4 mm of the disc. The next 33 mm are the data area; the outer edge is the lead-out area.

Audio CDs - CD-DA

CD-DA is an acronym for Compact Disc - Digital Audio. The specifications for CD-DA are laid out by the Red Book as defined by Philips and Sony in 1982.

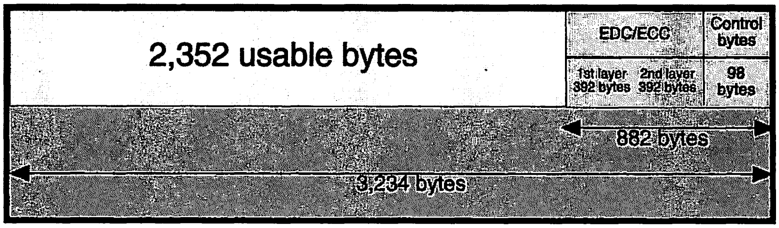
Audio data is recorded on these discs in a continuous line that spirals from the center of the disc and growing outward. The spirals form up to 99 tracks. The location of a track is called its address and is expressed as the absolute time for the laser to scan to that location (ATime) on the disc. Audio data is written to a track that is identified by its address. The relative time (RTime) is the time from the start of a given track.

What You Need To Know

Audio data is stored in 2,352 bytes of a sector. During playback, 75 sectors are read every second. A standard 12 cm audio CD has a maximum playing time of 74 minutes. A single-play CD, which has been available for a few years, is 8 cm in diameter and has a maximum playing time of about 21 minutes. These single-play CDs are designed to be played in any audio player.

The audio data is also scanned from the inside to outside and since the laser won't read past the lead-out area, the player will stop at the end of the music. However, there is a practical problem in that most CD players are not capable of properly holding single-play CDs.

It may be possible, however, to buy an adapter ring in an audio specialty store which clamps the single-CD into place like a stand CD disc.



The CD-DA sector layout

Audio CD playing time

Early audio CDs had a maximum playing time of 60 minutes. This limitation quickly became a problem. Prior to the CD, the most popular format for music was the LP for (Long Playing record). An LP could hold 37 minutes of playing time on each side and therefore the 60 minute limit for a CD was too short for a two-sided LP.

So, the audio CD capacity was quickly changed to accomodate 74 minutes of playing time (37 minutes X 2 sides). To achieve this, the length of the pits on the CD were shortened and the CD players were redesigned to play the outermost four millimeters of the CD disc.

The difference in the two capacities required different rotation speeds. Shortening the pits on a disc to be able to record more audio data required the drive to rotate slower during playback. With a 60 minute CD the rotation speed on the innermost track is exactly 568 rotations per minute; with a 74 minute CD this is 486 per minute.

CD+G and CD+MIDI

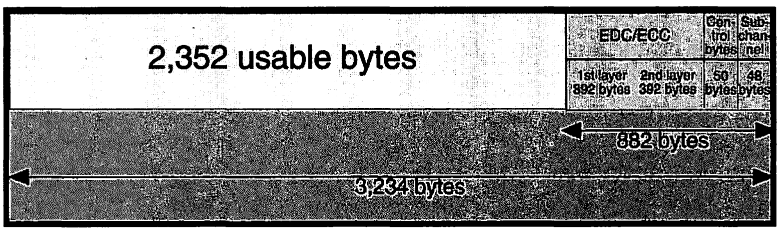
There are already been two variations to the CD-DA standard:

1. CD+G (CD-Graphics)
2. CD+MIDI

Both of these additional formats are also described in the Red Book.

The +G in the acronym stands for + Graphics. In the CD+G format, an additional 48 bytes per sector are used to record graphics data. At the normal rate of 75 sectors per second, this makes an additional 3,600 bytes/second available.

Where do we store these 48 bytes? They're stored in the R-through-W subchannel. We can depict the sector layout like this:



Sector layout for CD+G and CD+MIDI

This subchannel can be used to store text, music lyrics, or graphical information which you can view on a television, for example. Keep in mind that 3600 bytes is not a lot of room for graphics data so the resolution is rather coarse.

Here's a few examples of CD+G titles. By the way, the addition of "Graphics" below the actual CD logo tells you that this is a CD+G. You may already have a CD like this in your collection and not realize it.

Examples of CD +G titles		
Alphaville	*The Breaktaking Blue*	(Elektra)
Fleetwood Mac	*Behind the Mask*	(Warner)
Ella Fitzgerald	*Things Ain't This Way*	(Sire)

With new releases of the titles listed here you can plan on the additional information, or the +G part, being left out, so they will just be normal audio CDs.

CD+G is popular in certain parts of the world. For example, karaoke CDs are very popular in Japan. A karaoke machine displays the lyrics to popular pop and rock songs and lets you sing along with the music, which is produced in sync by the CD+Gs.

Players for CD+G are very rare. These are devices that are attached to the television and for which playing CD+G is a supplementary use. They include special CD-I players from Philips and other manufacturers, the Amiga CD32 player from Commodore and the Sega-CD console.

Developing software for playing CD+G discs on a PC isn't a huge feat. But it's very unlikely that this will happen, especially since most performing artists interesting in multimedia recording, prefer to work with CD-ROM or CD-ROM/XA.

Another way to use the R-through-W subchannel is for the CD+MIDI format (MIDI is an acronym for Musical Instrument Device Interface). In this format, MIDI data can be played in sync with the audio data, for example to control the lighting or for other special effects.

CD-V

CD-V or CD-Video, is actually a variation of the audio CD. Because of its name, this old standard, which was introduced into the market in 1987 is easily confused with the current video CD. CD-V is a very interesting medium based on CD-I and can include up to 74 minutes of video.

CD-V's are a gold color in appearance. The CD is physically different from an audio CD. Besides the digital sound information, it also contains analog picture information. CD-V belongs to the group of hybrid discs since the information is encoded differently (analog and digital). The analog picture information is encoded in a modified lands and pits. With the usual CDs, the size of the lands and pits is kept within exactly prescribed limit. Not so with CD-Video. The variation in size are converted into analog picture signals. The quality of the video information is slightly better than VHS.

A 12 cm disc holds about 6 minutes of analog video and digital sound. About 20 minutes of audio information can also be recorded. Since the CD-V was developed primarily for music videos, they're used to record several music tracks and an accompanying video clip.

A variation of CD-V is the CD-V EP (Extended Play). The CD-V EP is 20cm in diameter. Unlike CD-V, both sides of the CD-V EP disc are played giving a total of 80 minutes (40 minutes on each side) of sound and video information can be stored. This is sufficient for short movies ("shorts"), documentaries or other special interest videos, but not for full-length movies.

CD-V LP (Long Play) is more commonly known as the "laser disc". It's used for viewing full-length movies. The CD-V LP disc is 30 cm in diameter and has a playing time of 60 minutes per side. However, it has the disadvantage that quick movements in the picture can result in bumpy spots and poor definition because of video compression (MPEG). Despite this, laser discs have remained popular and are sold by many department, music and video stores.

Since the video signals on the laser disc (and on the other CD-Vs as well) are stored in analog form, the signals are converted to a television picture format. Therefore CD-Vs are usually made for the NTSC, PAL, and SECAM television formats.

To play a CD-Vs or laser disc, you need a separate player which connects to a television set. This precludes most CD-Vs from being used in the PC world. An exception are the 12 cm CD-Vs that can be played in traditional audio CD players or in CD-ROM drives. However, with these CD-Vs, you can only play the digital audio data.

There hasn't been an overwhelming demand for the 12 and 20 cm-sized CD-Vs. However, the 30 cm version of the laser disc has had moderate success as a way to view movies.

Computer CD Formats

The standard CD-ROM format

CD-ROMs are recorded in one of two types of sector formats:

- Mode 1: for recording data whose accuracy is critical
- Mode 2: for recording data whose accuracy is not as critical e.g. audio or graphics

Technical basics

The CD-ROM standards are defined in the Yellow Book which itself was derived from the Red Book. As a result, audio data can be recorded on CD-ROM which can then be played on CD-ROM drives.

There are two additional considerations that affect the layout of the sectors on CD-ROM discs that aren't factors for audio CDs:

1. Each sector on the CD disc must be directly accessible.
2. The sectors on the CD must be transmitted free of errors.

What You Need To Know

Direct access to the sectors

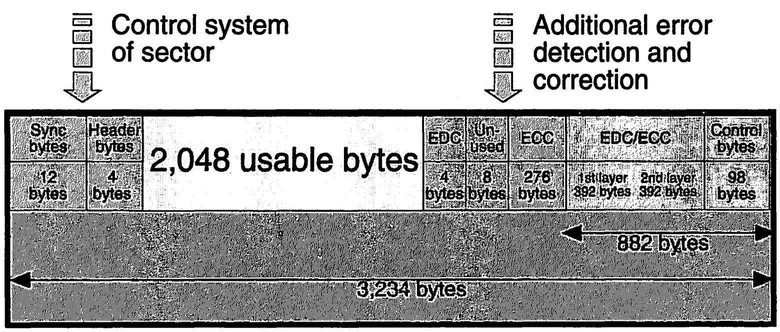
Unlike an audio CD, you must be able to access any sector on a CD-ROM disc. Earlier we found that the individual sectors on a CD are not physically separated but lie in a continuous track. To logically separate the sectors from one another, the CD-ROM uses sync bytes.

Each sector starts with 12 sync bytes. Four header bytes follow the synchronization bytes. The header bytes are used to identify the sector. The first three bytes contain the address of the sector. The fourth byte, called the mode byte, identifies the mode in which the sector data is stored.

Error recognition and correction

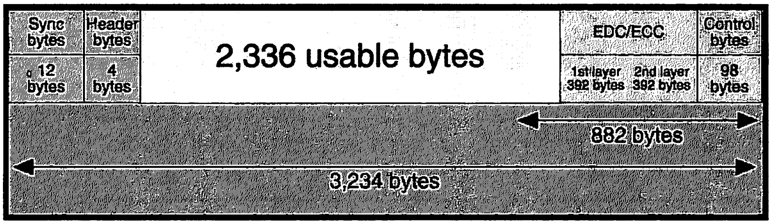
Earlier we found that each sector uses 784 bytes for EDC and ECC. This technique reduces the probability of error to 10^{-8}. But for computer data, this isn't an acceptable level.

When an CD disc is recorded in Mode 1, another 280 bytes are used for an additional level of error detection and correction. This second level of error detection and correction is called LEC for Layered Error Correction. Using four bytes for error detection and 276 bytes for the checksum data that is used to regenerate any erroneous data, the probability of error is reduced to 10^{-12}. This means for every 10^{12} bytes transferred, one will be read incorrectly. 10^{12} bytes is 10 million Meg. The probability of a one byte error per CD is less than 0.1%.



Error recognition and correction

This second level of error detection and correction is not used when a disc is recorded in Mode 2. Remember, this is the mode in which less sensitive data can be recorded. However, the sync and header bytes are present. Here too, individual sectors can be addressed.



The sector layout in mode 2

Mode 1 gives us 2048 bytes of user data in each sector and mode 2 gives us 2336 bytes. We can determine the data transfer rate from this information as follows: According to the standard, a CD-ROM drive reads 75 sectors per second. Multiply the size of a sector by the number of sectors and we find arrive at a familiar value 2048 bytes/sector X 75 sectors/second = 153,600 bytes/second = 150K/second.

For Mode 2, this turns out to be 171K/second. Since you cannot switch between Mode 1 and Mode 2 in the middle of a track, tracks are either Mode 1 tracks or Mode 2 tracks. In practice, Mode 2 isn't used very often. To read Mode 2 tracks, you need a special software driver. For CD-ROMs, Mode 2 is generally discussed in conjunction with CD-ROM/XA or CD-I.

You can see that Mode 2 is capable of transferring 170K/second while Mode 1 can transfer only 150K/second. The trade off in additional transfer speed of Mode 2 comes at the expense of the additional data integrity which Mode 1 provides.

	CD-ROM Mode 1	CD-ROM Mode 2
Data transfer rate	150K/s	171K/s
Probability of errors	10^{-12}	10^{-8}
User data	2048	2336
EDC and ECC	1162	882

A mixed-mode CD is one where audio data and computer data are stored on the same disc. This is done by writing audio data on one track and computer data on another track. A CD-ROM disc can have up to 99 tracks. The first track always contains computer data. The other tracks may contain either audio data or computer data.

The companion CD-ROM is a mixed-mode CD. The first track contains the table of contents of all applications and multimedia data. The CHECK-CD program, which is on the data track of the CD, can be loaded completely into memory from the CD-ROM so it can be started directly.

What You Need To Know

Track arrangement of the companion CD-ROM		
Track 1	Data track	This track can be addressed as a logical drive.
Track 2	Audio track	This track contains the audio data and can be addressed by audio CD players.

CD-ROM/XA

CD-ROM/XA is the eXtended Architecture extensions to the CD-ROM format and has three important features:

- Sector format - two new sector formats for either critical and non-critical data types.
- Interleaving - a method of mix Form 1 and Form 2 sectors on the same track.
- ADPCM (Adaptive Delta Pulse Code Modulation) - an new method for recording and reading audio data.

The first CD-ROM/XA definition was announced in 1989 by Philips, Sony and Microsoft. The work continued on specifications until March 1991 when it was published as an extension to the Yellow Book. There's likely to be an additional extension of both the Yellow Book and the CD-ROM/XA standard in the near future which include MPEG video compression.

One objective of XA is to improve the performance of multimedia computing. The XA standard lets you mix or *interleave* different sector *forms* within a single track. The result is that music or other audio data, videos, graphics or photos and program data can share the same track. This greatly improves the data transfer time.

XA also includes one element from the Green Book of 1987, which in part defines CD-I, namely ADPCM coding. ADPCM is used to better support multimedia applications. ADPCM is a method of storing audio data by recording the differences between the notes rather than the absolute tonal values. This type of compression makes it possible to store more audio data on the CD.

New XA sector forms

To be able to interleave sectors, the XA sector format is redefined. XA defines two forms:

- Form 1 for computer data.
- Form 2 for compressed audio, video and graphics data.

The big change from standard CD-ROM is the 8 unused bytes in CD-ROM Mode 1 are used as a subheader. These 8 bytes are used like this:

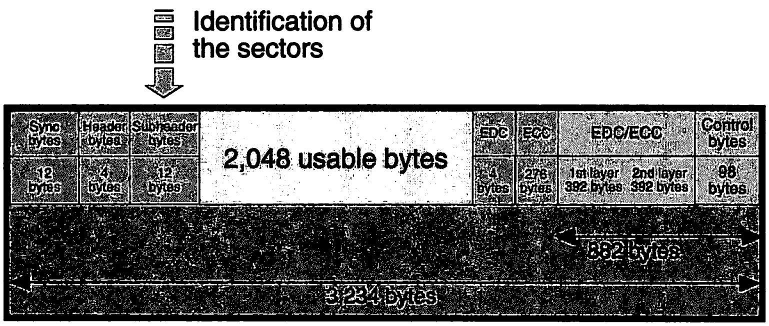
1 byte	File number
1 byte	Data channel
1 byte	Submode
1 byte	Control information
4 bytes	Duplicate of previous 4 bytes for data integrity

The file number is a value between 0 and 255. A 0 indicates that the file is to be read continuously rather than interleaved.

The channel number is multipurpose. Using channels makes it possible to read several sectors either separately or combined and to select them in real time. Channel numbers 0 to 15 are reserved for the ADPCM coding. Video and data sectors are assigned channel numbers up to 31.

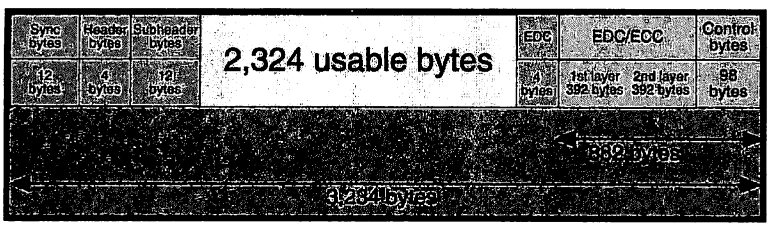
The submode is used primarily to indicate whether the data is computer data, video or ADPCM.

The control information indicates mono mode, stereo mode or which ADPCM level is used.



Sector layout of CD-ROM/XA Form 1

The 280 ECC bytes are not used in Form 2 which results in a higher number (2,324 bytes) of user data.



Sector layout of CD-ROM/XA Form 2 and CD-I

Other than these changes, the sector format of CD-I and CD-ROM/XA is identical. The high degree of compatibility between CD-ROM/XA and CD-I makes it possible to produce CD-I Bridge, where CD-I data can be written to a CD-ROM/XA disc. The XA standard is the basis for a number of other CD formats like the Electronic Books CDs (CD-EBs) and the Photo-CD.

Photo-CD

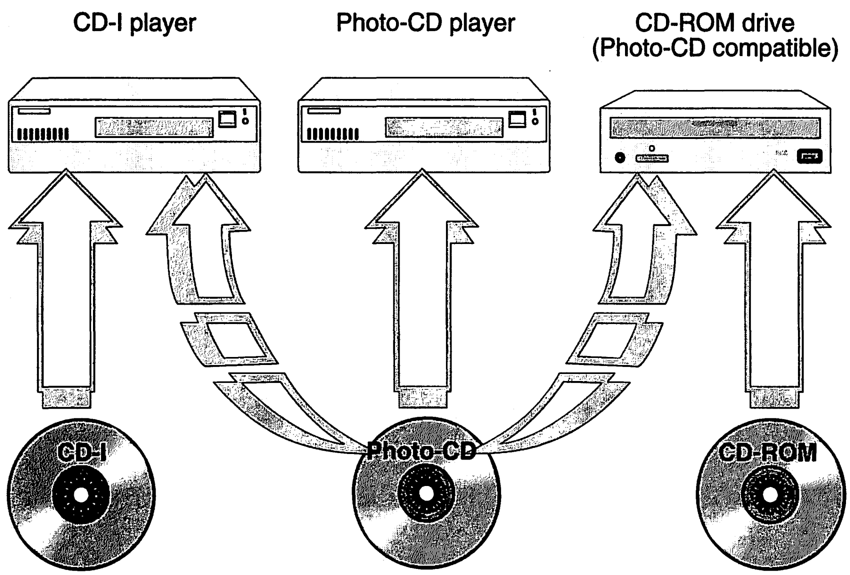
The Photo-CD, developed by Eastman Kodak and Philips, was introduced in the United States in 1993. The concept of the Photo-CD is simple. To preserve their revenues from the photography business which is now heavily reliant on film, chemicals and paper, Eastman Kodak is developing an alternative system for photographers. They take pictures and send the roll of film for processing. Instead of prints, the photos are returned as digitized images on a gold-color Photo-CD. By popping the Photo-CD into a Photo-CD Player, you can view up to 100 images on a television screen.

Originally targeted at the home shutterbug, the Photo-CD seems to have found its true niche among computer users. One of the reasons for this popularity is the explosive growth of CD-ROM drives which can also read Photo-CDs. Professional photographers can easily transfer their photographs to the PC. Once in the computer, the photos can be edited, retouched, enhanced and exported to other computer applications and or viewed on a Photo-CD player. This gives them much more opportunities for marketing their photographs.

In the meantime, other disciplines are finding exciting new uses for the Photo-CD. The scientific and medical community is using this technology for documentation and training.

The sector format for a Photo-CD is almost identical to that for a CD-I or CD-ROM/XA. Any additional CD-I information is stored in the root directory which makes it possible for a CD-I player to read the data. The following illustration shows that Photo-CDs can be viewed not only on Photo-CD players which are designed solely for that purpose, but also used on CD-I players and many CD-ROM drives.

Photo CD compatibility



There is one major difference between a Photo-CD and a CD-ROM. The interesting part of this technology is that the disc can be written to multiple times. You can add photo images from a second or third roll of film, for example. To be more accurate, the Photo-CD is a type of CD-R (recordable) disc that is specified in the Orange Book. Since multiple recording sessions (e.g. processing another roll of film) can fit on a single Photo-CD, each with its own lead-in and lead-out, the term *hybrid CD-WO* is used to describe the method.

The hybrid CD-WO

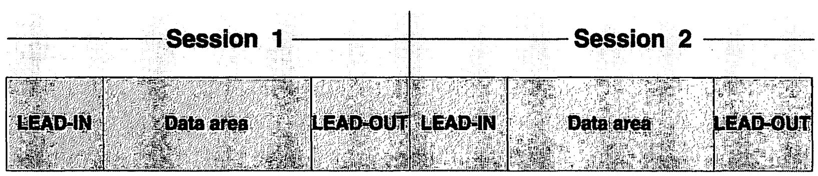


Photo-CDs are produced by technical processing houses called imaging or photofinishing centers. These centers are licensed by Eastman Kodak to produce the discs. The photographic film is developed as usual. But instead of making paper prints, the negatives or slides are digitized using a high-resolution scanner. The digitized images are recorded to the Photo-CD disc in several resolutions using a CD-ROM recorder.

Variations of the Photo-CD

The usual Photo-CD, called the Photo-CD Master, contains a maximum of 100 pictures.

Another version, the PRO-Photo-CD, is for users who require higher quality images. Photographs are scanned and written to the Pro Photo-CD disc at a higher resolution. At this resolution, the capacity is limited to 25 images.

Another version is the Portfolio Disc. The Portfolio Disc can be thought of as a digital photo album. You can store both photo images and audio information. The imaging center can add the audio information from your audio cassette, DAT tape, audio CD or digital sound file which you supply. Up to 800 pictures or 60 minutes of audio can be stored on the disc.

The Catalog Disc is another variation. Many believe that the Catalog Disc may eventually replace mail-order catalogs, large references or serve as a photo archive. The pictures on the Catalog Disc are stored in a TV-compatible formats, but several thousand pictures can be stored this way.

Another format that is planned in the Medical Disc, which is used to store scanned MR data, X-rays, ultrasound pictures and the like.

For more information on Photo-CD, see "The Photo-CD Book" also published by Abacus.

CDs For Entertainment And Information

CD-EB, CD-EB/XA and Cross-platform CD

Sony is the inventor of a portable CD system and player called Data DiscMan. These discs are called Electronic Book CDs or CD-EB. Some of the titles include reference works, maps, encyclopedias, and other books.

CD-EBs are made in two sizes depending on the type of drive used. An 8 centimeter disc (about 3 inches) is used in a portable model. A 12 centimeter disc (about 4 3/4 inches) is also available. The basis for the sector format is the conventional CD-ROM specification or the CD-ROM/XA standard; in the latter case, sometimes the CDs are referred to as CD-EB/XA. An 8 cm CD-EB using Mode 1 has a capacity of 180 Meg; one using Mode 2 can hold up to 210 Meg.

A portable player for a CD-EB may have one of several names depending on the manufacturer. Some of these include Data DiscMan or Electronic Book Player. Regardless of their name, these are portable, battery-driven drives, small LCD screens and headphones.

The larger 12-cm CD-EB uses the standard sector formats, but because they require special player devices for access to the data, they cannot be used in a CD-ROM drive. A plan has been developed in the meantime to provide a platform which would make CD-EBs accessible to DOS and Windows machines as well.

Cross-platform and Multi-CD-ROM

Sony's strategy is to provide cross-platform CDs compatible for different operating systems. Currently CD-ROMs designed for a PC will not run on an Apple Macintosh or a Commodore Amiga, for example. The compatibility problem is not so much in the data, but rather the programs. The original idea behind the cross-platform CD is to store the different programs for the various computers in separate directories on the disc. Each of the different programs would access the same set of data.

Sony is preparing a Multi-CD-ROM. This is an 8-centimeter CD-EB with software for DOS, Windows and Macintosh computers. This cross-platform CD will be able to run on Electronic Disc Players, on Windows computers and on the Apple Macintosh. Sony plans to offer all the popular CD-EB titles as Multi-CD-ROMs.

CD-I, CD-Movie

We mentioned that CD-I is an acronym for CD-Interactive and was developed by Philips. CD-I discs cannot be used in CD-ROM drives. Special CD-I players are required, which can be connected to stereo systems and to television sets.

The Green Book: Specifications for CD-I

The Green Book defines the standard for CD-I. The sector layout is similar to that of CD-ROM/XA. CD-I uses the audio technology from the Red Book and levels A to C of the ADPCM audio code. CD-I also supports video compression using a variant of the MPEG process, which will be included in next level of the CD-ROM/XA specifications. CD-I players currently use a Motorola 68070 processor from the 68000 family of chips. A special CD-I operating system called CD-RTOS (Compact Disc Real Time System) controls the CD-I player. CD-RTOS is the main reason the CD-I is incompatible with MS-DOS computers.

Depending on the type of data, either CD-ROM/XA Form 1 or CD-ROM/XA Form 2 is used for the sector format. As in the XA standard, sectors containing different types of data (programs vs. graphics, video, or sound) can also be interleaved for CD-I discs. This guarantees an uninterrupted flow of data. Audio data can be stored as CD-DA tracks or encoded using ADPCM.

The Green Book also defines the supported graphic resolutions, which are oriented on the TV standards:

	NTSC	PAL
Normal resolution	384 x 240	384 x 280
Double resolution	768 x 240	768 x 280
High resolution	768 x 480	768 x 560

The color representation on the screen can be different, depending on the application. The following processes are possible:

- The DYUV process for true color and photorealistic effects. It displays up to 16.7 million different colors.
- RGB 5:5:5 for computer graphics. Up to 32,768 colors are possible. RGB 5:5:5 means that the basic colors of a pixel are coded red, green and blue, each with 5 bits.

CD-I-Ready

A CD-I-Ready disc combines both modes of CD-I. While it's an audio CD, it may also contain graphics, pictures and text data on it. However, you can only use these features from a CD-I player.

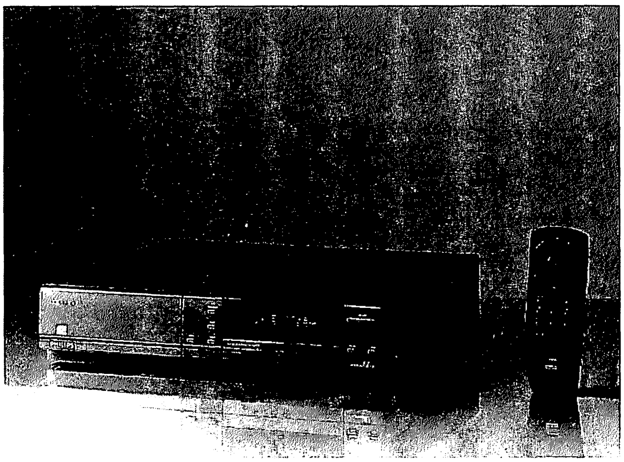
Text and graphics are recorded to a CD-I-Ready using a different technique. The graphics, text, etc. are written in front of the audio tracks by making use of a capability defined by the Red Book for setting indices. An index is used to mark track locations which can later be addressed directly, assuming the audio player supports this feature. Normally, only indices 0 and 1 are used. Index 0 marks the start of the track while index 1 marks the start of the audio data.

The pause between the two indices is the *pregap of about* two seconds in length. Audio players skip over the pregap to the first audio data. In CD-I, the pregap preceding the audio track is lengthened to 180 seconds. The graphics or text data is then written to the pregap space. An audio player ignores this area, but a CD-I device reads the data and then display the graphics or text on the television. Since the location of an index is variable, the size of the pregap area can be longer than 180 seconds.

If you insert a CD-I-ready disc into a normal audio player, you'll be able to access only the audio. Don't press the reverse key to try to play what precedes the first piece of music. If you do, the audio player will try to access the graphics and text which could damage your player and/or stereo.

Players

Although CD-I was first announced in 1986, they were not introduced into the United States until 1991. Other video entertainment equipment manufacturers have licensed the system from Philips and now offer their versions of the CD-I player. These players range from the portable CD-I player with a built-in color display to computer-like total systems with a mouse and keyboard.



The CD-I player

In addition to CD-I discs, you can also play Photo-CDs on a CD-I player. You cannot however, play a CD-I disc in your CD-ROM drive.

Key applications on CD-I?

Until now, CD-I hasn't been as successful as Philips has expected. While the CD-I system has very interesting possibilities, consumer acceptance depends heavily on the number and quality of available titles. So far the CD-I titles, are limited in number. They include games, entertainment, education and reference works.

Unfortunately for CD-I, its greatest competition is the CD-ROM. The overwhelming success of the CD-ROM in computers makes the standalone CD-I player less attractive to consumers. It's much less expensive to add a CD-ROM drive to a computer system than to buy a CD-I player. One promising development for the CD-I may be in connection with CD-Movie.

What You Need To Know

CD-Movie

CD-Movie represents a second chance for CD-I. A CD-Movie is a CD-I disc which can contain up to 74 minutes of compressed video. The video itself is full-motion, at 25 frames per second and full-screen. It's compressed using a process called MPEG (Motion Picture Experts Group). The MPEG-1 specification has been used with CD-Movie until recently. However, the MPEG-2 standard will be used for the next development of the CD. The MPEG-2 standard promises better picture quality.

What do you need to play a CD-Movie?

To play CD-Movie, a CD-I player needs an MPEG decoder to process the compressed video data. One big limitation affecting it chances of success is CD-Movie's 74 minute limit. This is too short to accomodate most full length movies.

Commodore's game console, the CD^{32} is capable of playing CD-Movies. You can also connect the CD^{32} to a PC as a standard CD-ROM/XA with an MPEG decoder card.

More CD applications - CDTV, CD32, Sega-CD and 3DO

These four products use CD technology primarily for video games.

CDTV

The CDTV is not defined in any of the "rainbow" books. CDTV is a game console developed by Commodore. It is basically an Amiga computer with a built-in CD-ROM drive. The acronym CDTV sounds as if it should stand for Compact Disc and Television; it actually stands for Commodore Dynamic Total Vision. Data from the CDTV player is displayed on a standard NTSC or PAL television. You can also play audio CDs and CD+Gs on CDTV systems.

CDTV is based on the sector format Mode-1 and Mode-2 of the standard CD-ROM format. The files are formatted according to ISO 9660 Interchange Level 2, which means that they're not compatible with CD-ROMs. CDTV can display 16 colors at a resolution of 640 X 512 or 64 colors at a resolution of 320 X 256.

One problem with CDTV is that you have to load the program data completely into memory before it runs. In other words, it's not possible to have a continuous data flow like that available with CD-ROM. Two exceptions are:

1. Synchronous sound on audio tracks
2. Animated pictures based on the proprietary CDXL standard.

With CDXL, up to 4,096 colors can be displayed simultaneously, at a screen resolution of 320 x 256. The CDTV player is sold in two versions. The first is as a standalone console with the designation CDTV. The second which includes additional peripherals is called Amiga CDTV. A CDTV player can also play audio CDs, CD+G and CD+MIDI discs.

Other disadvantages of CDTV are its incompatibility with the CD-ROM/XA standard and the fact there are few applications. Most titles are older Amiga programs rewritten for CDTV. CDTV lags behind CD-ROM and CD-I technically. The CDTV was discontinued in the summer of 1993. However, another system followed.

CD32

In the fall of 1993, Commodore introduced the CD32 as the successor to CDTV. This is a device resembling more a video game console than a CD player; in short an entertainment product.

CD32 is an upgrade of CDTV. It adds new graphics capabilities for using up to 256 colors from a palette of 16.7 million colors. In fact, all the electronics of an Amiga computer, including the powerful 68020 microprocessor, is embedded in the CD32 player. The operating system is very similar to the Amiga operating system Version 3.0.

The sector format of these discs is either the traditional CD-ROM Mode-1 or Mode-2 or CD-ROM/XA. A PC cannot share the discs from a CD32 since the software is incompatible. New software, mostly games, are available for the CD32 console. Earlier CDTV titles are compatible with CD32.

Future enhancements are planned by Commodore and include expansion boxes to let you expand a CD32 device into an Amiga. They're also planning an MPEG decoder so the CD32 console can play CD-Movies.

As of this writing, the future of Commodore is unclear. In the U.S., they've filed for protection from creditors under Chapter 11 of the Bankruptcy Code. We'll have to wait to see what becomes of this interesting technology.

Sega-CD

The Sega Genesis game console has been an overwhelming success among video game enthusiasts for several years. Late in 1993, Sega introduced a compatible but enhanced version of their game console with a built-in CD drive. This console uses a CD-ROM disc based on the Yellow Book which can also read audio CDs and CD+Gs. PCs, however, cannot use these CDs because the software requires the special Sega-CD operating system. Sega-CD games are even more elaborate than their cartridge counterpart. They have excellent sound and graphic features in part due to the huge storage capacity of the CDs. Nintendo, the other major video game maker, has a similar game console under development.

What You Need To Know

3DO

The 3DO Company, whose name is an acronym for 3-Dimensional Optics, makes a console that is both a games and entertainment medium. The 3DO console is named the Interactive Multiplayer. It features advanced graphics and RISC-based microprocessor that make this an impressive and powerful system that hook directly into a television. It's capable of reproducing high quality sound, full-screen video and high resolution animated graphics. It's double-speed drive can play audio CDs, video CDs and Photo-CDs. More than three hundred applications are being written for the 3DO console.

Recordable CDs

There are three major types of recordable storage media which use optical scanning technology:

CD-WO

The CD-WO acronym stands for Write Once. This medium is housed in a plastic cartridge and as its name suggestions, you can write to a CD-WO exactly once. A specialized drive is required to record and read data from CD-WO.

CD-R

CD-R for Recordable is also a write once type medium. The difference between CD-R and CD-WO is that the medium is identical in size and sector layout as a CD-ROM. This type of storage medium uses a disc without a cartridge. Its size and the layout of sectors are the same as a CD-ROM, so a CD-R disc can be used in a standard CD-ROM drive.

CD-MOs

CD-MO discs (Magneto Optical) are also housed in a special cartridge. A specialized drive, are called an optical drive, records and reads data from these cartridges. Optical drives can write to a CD-MO many times. The data can be erased and overwritten using MO technology.

Different approaches of rewritable CDs

Matching up CDs and computers makes a lot of sense. Laser scanning technology makes it possible to pack huge amounts of data onto a small, durable and inexpensive piece of plastic. One major drawback of the CD-ROM is that it's a read-only medium.

Before we can consider it a "perfect" storage medium, we have to be able to write to a CD. Early on, engineers experimented with techniques for recording directly onto the disc. There were many problems to overcome including burning holes into the plastic surface of the disc; maintaining the narrow .6 micrometer track width with a high energy laser; ensuring an exacting pit depth.

Soon the engineers changed their approach. Rather than recording the data directly onto the plastic layer they coated it with a special chemical resist. They then used a laser beam to *burn* the data onto the disc.

A second method uses a polymer plastic on one layer on the bottom and a vaporized metal layer on top. As the metal layer is heated by the laser beam, the polymer layer underneath is vaporized leaving a blister which lifts the metal layer. A reading laser can then detect the changes to the disc surface and interpret them as data.

WORM technology

The WORM acronym stands for Write Once Read Many. WORM is a generic term form a storage system that uses optical technology. WORM devices are based on a process developed by a Japanese component manufacturer, Taiyo Yuden.

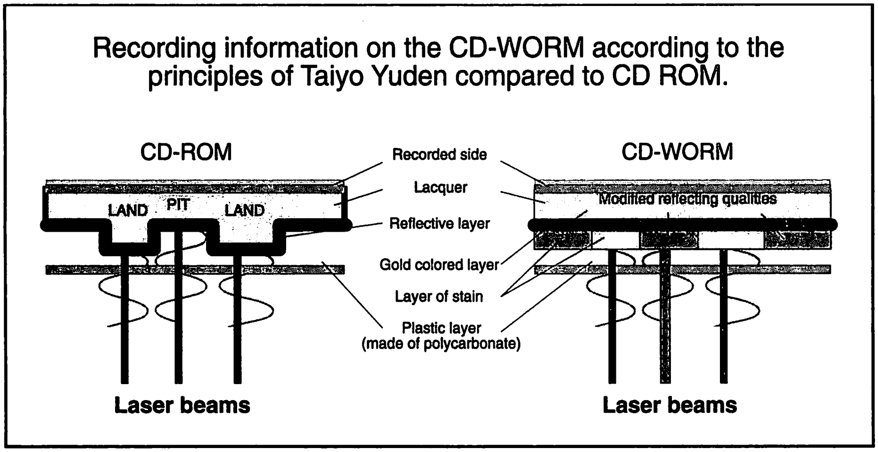
Like a CD-ROM, a WORM disc is also made of a polycarbonate material. The disc is coated with a thin layer of dyed polymer material followed by a layer of gold-colored reflective material. When a recording laser strikes the polymer, the reflective material shows through the hole that is burned into it. The gold-colored coating provides better reflection than traditional silver-colored coatings. A weak laser is used to read the data. Since the read laser is much weaker than the recording laser, it cannot change either the polymer layer or the data.

Blank WORM discs are preformatted. A track 0.7 micrometer wide is impressed in the polycarbonate layer. However, this groove can appear differently depending on the formatting process. Using a Sampled-Servo process (SS), a track is a single spiral groove, like the CD-ROM. Using the Continuous-Composite-Servo process, the track consists of several concentric circles like on a hard drive.

Sony, Ricoh and Maxtor hardware use the more popular CCS process. Philips, Pioneer and Optimum hardware use the Sampled-Servo process. A WORM cartridge from a drive that works using the Sampled-Servo process cannot be used in a drive which uses the CCS process and vice versa. Nor can the blank WORM discs be interchanged because of the pre-formatted track. In fact, blanks from two different devices that use the same process might not even be compatible.

What You Need To Know

CD-ROM and WORM recordings



CD-WORM, CD-WO and CD-R?

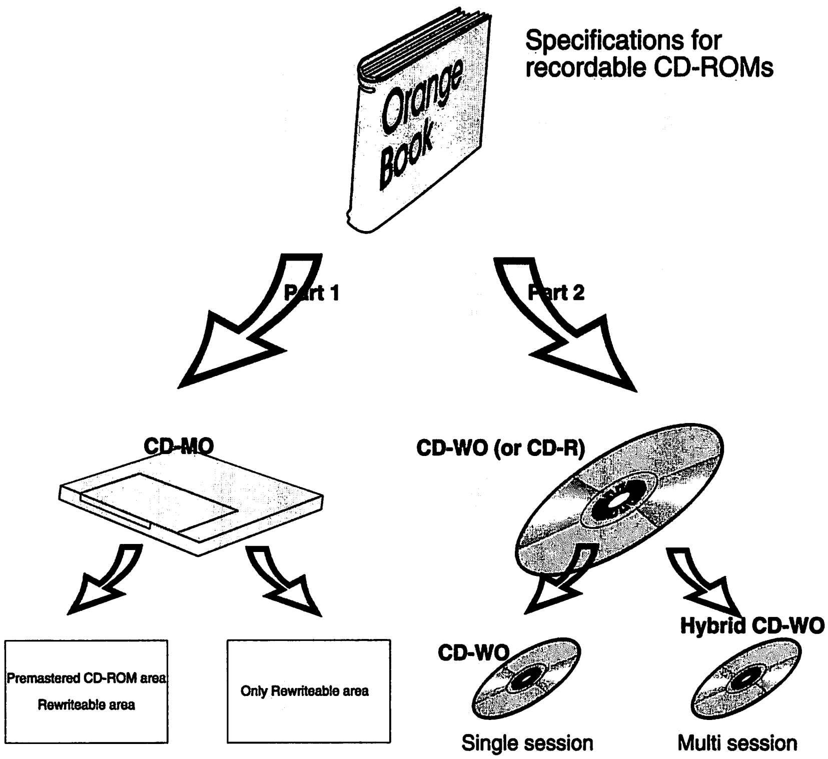
The designations CD-WORM, CD-WO and CD-R are frequently used interchangeably. The basic technology for all three is based on WORM. But the common name for this is CD-WORM. Several alternative recording methods are based on WORM techniques. In fact, CD-R is a special case of WORM.

As we mentioned, WORM has no standards. It's generic since the size, capacity and medium packaging can vary. On the other hand, there is a standard for CD-R. The medium is the same size, capacity, package and sector format as a conventional CD-ROM.

The Orange Book standard for writable CDs

The Orange Book, specified by Sony and Philips in 1991 lays the groundwork for compatibility among writable CDs. It's divided into two parts. The first part defines CD-MO. The second part defines CD-WO (Write Once), which is more commonly called CD-R (Compact Disc Recordable).

The layout of the Orange Book



The Orange Book contains the specifications for recordable CD systems. Part 1 defines the CD-MO, which is made up of a premastered area combined with a rewriteable area or else consists of only a rewriteable area. The premastered area corresponds to the rewriteable MO format, while the rewriteable area corresponds to a CD-ROM compatible track format. Part 2 of the Orange Book defines the CD-WO and CD-R.

WORM successors

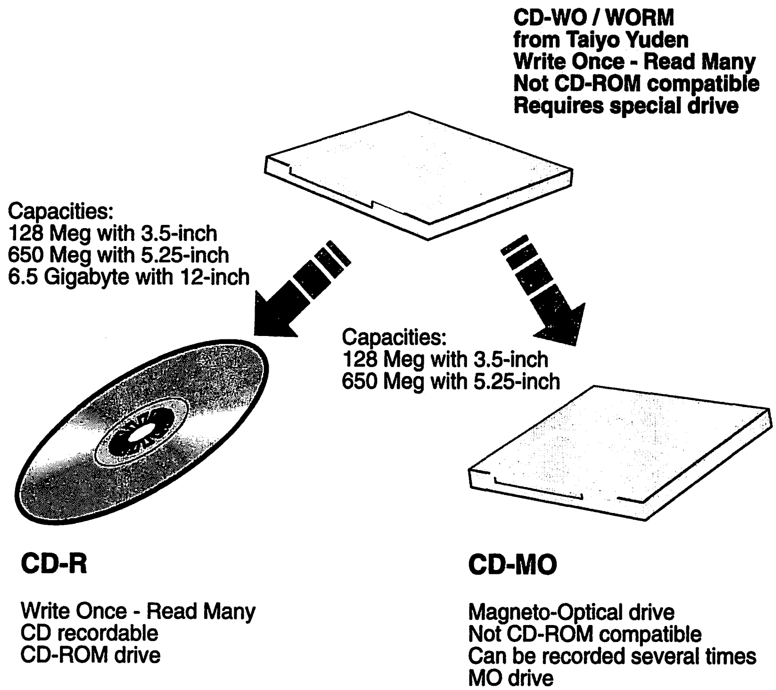
WORM is a write-once disc enclosed in a cartridge and is still in limited use today. But the technology has two major limitations:

1. A cartridge-based medium affects the cost, compatibility and adaptability of the WORM technology. To counter this limitation CD-R was developed.

2. A write once medium limits WORM technology to applications that can adapt to static data. To overcome this limitation CD-MO was developed. We'll see how CD-MO works shortly.

What You Need To Know

The development of the rewritable system



The technology behind CD-R

CD-R is based on WORM technology to write to a preformated disc. As with CD-ROM, CD-R uses the CLV (Constant Linear Velocity) technique to record and read data. To do this the rotation speed of the disc is varied. The rotation speed is faster when accessing data closer to the outer edge of the disc and when accessing data closer to the center. It changes from about 500 RPM to 200 RPM. Preformatting a CD-R disc writes a .7 micrometer-wide track containing information that is later used to control the rotation speed and other timing characteristics. During the recording, the laser aligns itself along this track.

You can record data on a CD-R only once. After recording the disc can be played in a normal audio CD player or in a CD-ROM drive. You can record all format with a CD-R except CD-V.

The Orange Book also defines the specifications for a hybrid CD-WORM. Data is recorded to a hybrid disc in multiple sessions, each with its own lead-in and lead-out. Each session is append to an earlier session so no area of the disc is overwritten. In other words, the track is extended during later sessions. The Photo-CD is a hybrid CD-WORM.

CD-R Applications

CD-R has many useful applications. Once written to, the data on a CD-R cannot be changed. This is perfect for protecting against unauthorized changes to the data such as accounting ledgers after closing the books or historical payroll data. CD-Rs are widely used for archiving data such as this .

The other main use for CD-Rs is for prototyping a CD-ROM master. This lets the user try different arrangements of programs, audio and data on a CD before a large production run. This is an economical and time saving way to try the applications without having to use a service bureau.

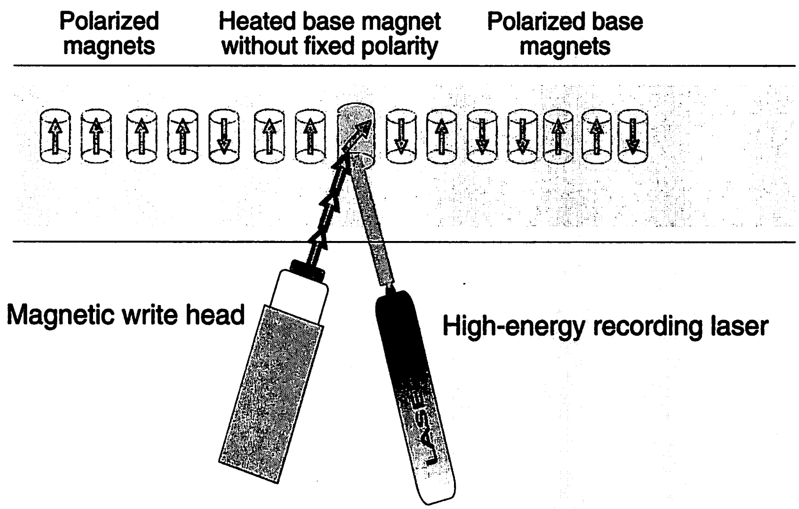
CD-R is also an economical way to produce a small number of CD-ROMs when mass duplication isn't a consideration, but the other advantages of using a CD are important

The technology behind CD-MO

Three different physical properties are used in CD-MO technology: Magnetic, optical and thermal. An MO disc, or MOD for short, is made from an aluminum platter covered with a metallic alloy. During recording, a powerful laser beam is focused on the disc surface which heats it to its Curie point (about 200 degrees). At this temperature, the molecular structure of the disc is easily altered. An electromagnet, similar to the write head in a conventional hard drive, changes the polarity of the nearby heated molecules to represent the data. The polarity (and therefore the data) is set as the material cools only a fraction of a second later. The affected area is so small that 650 Meg of data can be recorded on a 5 1/4" MO.

To read the data, a technique based on the Kerr Effect is used. In 1875, Scottish mathematician John Kerr found that the reflection of light beams is effected when they pass through a magnetic field. In CD-MO, a second, less powerful laser beam is focused at the disc surface. As it passes through the alloy, the light is polarized by the alignment of the molecules that were arranged by the magnetic recording process. A photodiode sensor translates the polarity of the reflected beam into the binary data.

The recording method for CD-MO



The high-energy recording laser heats up the special position on the recording layer above Curie point (Curie temperature) so an electromagnet can polarize the base magnets.

The rewritable CD-MO

The Orange Book defines two data areas for CD-MO:

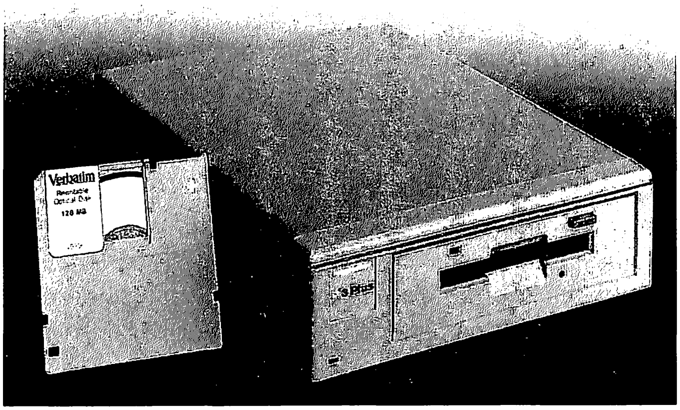
1. The rewritable area in which data can be recorded multiple times.

2. The premastered area where read-only data can be recorded. This is optional.

Before recording to the CD-MO, you can partition the disc into the premastered area (if any) and the rewritable area. The premastered area has CD-ROM-compatible tracks, which can be read by a CD-ROM drive. You won't be able to do this if the MO disc is a cartridge or has a size other than 8 or 12 cm in diameter. The data in the rewritable area cannot be read by a CD-ROM drive. A hybrid drive can access both areas. These drives have combined reading and writing units for reading and writing within the rewritable area and for reading within the premastered area.

Most users want a mass storage device that works like a hard drive. They want to be able to write, delete and overwrite data. For these users, MO drives, commonly known as optical drives, are at a distinct advantage compared to CD-R. Since optical media is enclosed in a cartridge, you can't access the data using a CD-ROM drive. In fact, optical media recorded in one drive from one manufacturer may not be compatible with a second manufacturer's drive.

An optical drive



Optical drives are classified in two ways based on the size of the cartridge:

	NTSC	PAL
Normal resolution	384 x 240	384 x 280
Double resolution	768 x 240	768 x 280
High resolution	768 x 480	768 x 560

Not surprisingly, many of the newer drives are capable of writing to two sides of the cartridge. For these drives, this effectively doubles their capacity to 230 Meg and a whopping 1.3 GB, respectively. Optical drives are typically used in applications such as desktop publishing, image processing, and in other areas where large volumes of data are processed.

A 128 Meg optical drive is about the size of a lunch box and ranges in price from $800 to $1100. The cartridges cost about $50. A 650 Meg optical drive is slightly larger in size and costs $1800 to $2500. A 650 Meg cartridge costs about $100. A 1.3 gigabyte optical drive ranges in price from $2200 to $3500 and a cartridge about $120.

The performance of an optical drive isn't quite at the same level as conventional hard drives. Most hard drives have an average seek time of 10 to 16 ms (milliseconds). For optical drives this value varies from about 24 to 40 ms. Data transfer rates for optical drives vary greatly from 640K/sec to upwards of 2Meg/sec so they're much faster than most CD-ROM drives. However, optical drives are clearly slower when writing data.

Chapter 4

What You Need To Know

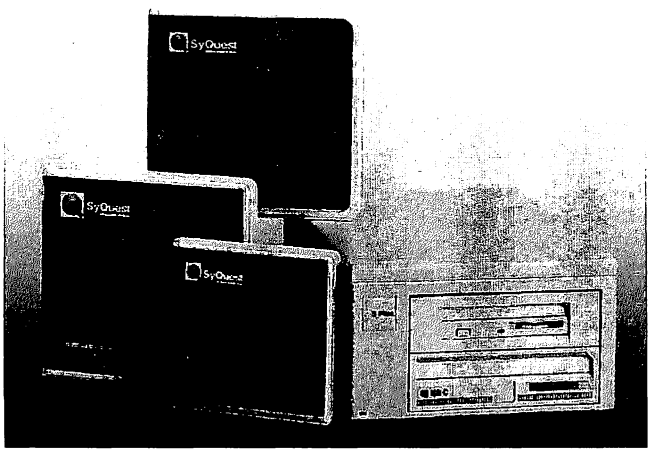
Optical drive considerations

If you're thinking about buying an optical drive, make note that these drives are taller than their 3.5-inch or 5.25-inch hard drive counterparts. Compare the height of a drive bay and the optical drive to make sure that it will fit into your computer case. One way around this is to buy an external optical drive.

Optical drives are connected to the PC through a SCSI interface, so your computer will have to have a SCSI adapter board. You'll also want to make sure that the optical drive includes the correct connecting cable and appropriate SCSI software that identifies the drive as having Removable Optical Media. If your PC is already set up for other SCSI devices, then the chances are good that the SCSI drivers for the optical drive are already available, especially if they are ASPI (Advanced SCSI Programming Interface) compliant.

Overview of CD storage media

We've spent a considerable amount of time describing the different types and variations of storage media. In addition there are two non-CD types of mass storage that we can touch on. One is the Syquest removable disk which has been used since the early 80's. These are traditional hard drives packaged in a removable cartridge. They are widely used, but are limited to a capacity of 270 Meg.



The second are PCMCIA cards. These are credit card-sized storage media that are used primarily in notebook, subnotebook and palmtop computers. There are several types of PC cards. One type of card is only 10.5 millimeters thick but has a miniature hard drive with a storage capacity of 105 Meg. It is inserted into a PCMCIA slot in the computer.

The following table summarizes many of the characteristics of the different media.

	Capacity (in Megabytes)	Access time	Data transfer rate
CD-ROM	640	200-300 ms	150K/s 300K/s 600K/s
CD-R	640	200-300 ms	150K/s 300K/s 600K/s
Optical 3.5-inch	128/230	50 ms	600K/s
Optical 5.25-inch	650/1.3 gigabytes	25 ms	300K/s
CD-WORM	650	100 ms	1 Meg/s
Hard disk	500	12 ms	1.2 Meg/s
Diskette 3.5-inch	1.44	120 ms	80K/s
Tape drive	250	minutes	400K/s
Diskette 3.5-inch	1.44	120 ms	80K/s
Hard disk	1 gigabyte	8-20 ms	1.2 Meg/second
Floptical	21	8 ms	160K/s
Syquest 5.25-inch	44/88/200	20 ms	2Meg/s
Syquest 3.5-inch	105/270	14 ms	4Meg/s
PCMCIA	105	15ms	2Meg/s-10Meg/s

The Rainbow Books

The Rainbow Books are the "Bible" for the different CD-based storage technologies. We've summarized them here:

Book	Specification
Red Book	Audio-CD
Yellow Book	CD-ROM; in the expanded version for CD-ROM XA
Green Book	CD-I
Orange Book	Rewritable CDs
White Book	Bridge disc
Blue Book	Future system: CDs with a capacity of 6.5 gigabytes

What You Need To Know

The Rainbow Books define the physical attributes for CD-ROM recordings. However, they do not specify the way in which the files on a CD are organized.

For computers, file organization is dictated by the computer's operating system. File organization specifies many details including:

- How file names are arranged
- How files are logically stored on a medium

There was not standard file system for early CD-ROMs. Apple, for example, adopted its HFS (Hierarchical File system) for Macintosh CDs. But as Macintosh floppies can't be read by a DOS computer without a program that understands the Macintosh file structure, Macintosh CD's aren't compatible with DOS computers. The UNIX file system is incompatible with the two other operating systems.

In 1985, industry representatives from Apple, Digital Equipment, Hitachi, Microsoft and others, met to create a uniform file system for accessing CDs. A paper, called the High Sierra Group Proposal (named for the location of the conference), was expanded later as the Working Paper for Information Processing Volume and File Structure of Compact Read Only Optical Discs for Information Interchange of the International Standardization Organization (ISO).

ISO 9660 standard

The ISO 9660 standard defines a file system for two levels: Interchange Level-1 and Interchange Level-2. There are two levels to accomodate different length file names. Level-1 meets the DOS conventions, while Level-2 provides for longer file names. The major specifications include:

File names	A file name can contain only the upper-case letters A to Z, the numerals 0 to 9 and the underscore (_) symbol. Although DOS is able to use other special characters, they are not permiited in the ISO 9660 standard.
Interchange Level-1	File names can have a maximum of eight characters for the basic name and three additional characters for the extension.
Interchange Level-2	File names can have a maximum of 30 characters
File organization	Files are organized hierarchically in directories and subdirectories. There can be up to 8 levels of directories. Directory names are limited to a maximum of eight characters mentioned above. A directory cannot have an extension.

Normally, the two interchange levels are not compatible with one another. If a CD-ROM has Interchange Level-2 file names up to 30 characters long, they cannot be used on a system that limits file names to eight characters. However, the opposite is true as well. When users and developers talk about ISO 9660, they're usually referring to Interchange Level-1. Any work on Interchange Level-2 is explicitly noted.

The advantage of a CD that conforms to the ISO 9660 Interchange Level-1 standard is that it can be used on DOS/Windows computers, UNIX systems, and Macintosh computers. For example, it can contain programs and data for Unix, DOS and Macintosh. Keep in mind that although a DOS computer can read a Unix program from the disc as a file, it cannot run these programs.

CD-ROM drivers

The software which allows access to the ISO 9660 file system under DOS was developed by Microsoft. This is the MSCDEX.EXE driver which we described earlier. MSCDEX is a high-level driver, which also requires a low-level driver. Its job is to coordinate the interaction between the operating system and the CD's file system.

Apple computers have a special driver for this task, which is stored in the system folder. To ensure the complete support of the ISO 9660 standard with file names of the Interchange Level-1 on Unix computers, in the early 90's several companies drafted the Rock Ridge Interchange Protocol (RRIP).

Manufacturing CD-ROMs

The production of CD-ROMs is based on the methods developed for manufacturing audio CDs. Although there are differences in the premastering process and the quality assurance, the two are very similar.

Step by step

It's easy to describe how a CD is manufactured. It isn't easy to describe how to capture, create and collect the large volumes of data that are to be written to the CD. It's even more difficult to describe how to write a program or interface that accesses this CD data.

As this book isn't a developer's guide for CDs and CD applications, we'll skip these later two topics. Suffice it to say that a lot of hard work and long hours typically go into preparing the information for the CD and a lot harder work and longer hours are spent designing the programs and applications.

Here's the steps that are involved in producing a CD-ROM:

Chapter 4

What You Need To Know

- Premastering
- Mastering
- Duplication
- Quality Control

Premastering

CDs are made using sophisticated equipment in a highly controlled environment. Even so, because tremendous amounts of data are written to a disc, microscopic dust particles and other environmental factors can cause errors on a disc as it is manufactured.

Fortunately, the multilevel error detection and error correction techniques used during playback are able to correct these errors. To make this correction possible, the detection and correction code are added to the source data. This essential task happens during premastering.

Data that is to be written to a CD-ROM is usually sent to a service bureau that specializes in preparing CD-ROMs for mass duplication. You can send the data to these service bureaus on a variety of media: 4mm DAT tapes, 8mm cartridges, 9-track tapes, SCSI hard drives, or even floppy diskette.

Premastering usually includes a step to make sure the files adhere to the ISO 9660 standards. The data files may be text information, digitized images, graphics or executable program code. During premastering the EDC/ECC information is added to the data.

Audio data is usually handled separately. The audio is sent to the service bureau on a separate digital tape. During premastering, these audio tracks are written to those areas of the CD-ROM that are set aside for this type of data.

As we mentioned above, the main job of premastering is to insert the error detection and error correction codes into the data stream. This adds 288 bytes of additional data to each 2K block or original. Synchronization bytes and header information are also placed at the front of each 2K block. Roughly speaking, after premastering, the image file is 15% larger than the original data.

Depending on the type of recorder, premastering is performed by software or hardware. Using a hardware encoder, the time for premastering 655 Meg of data is about 2 hours compared to about 5 hours for software only encoding.

Premastering also generates the time code, table of contents for the tracks and address fields for the Q-channel. The "data present/not present" information is also prepared for the P-channel. The table of contents which has yet to be written to the CD-ROM contains information about the total length, pauses and types of tracks.

Mastering

Recall that a CD-ROM is a plastic disc about 4.75 inches (12 cm) in diameter. The data is stored on one side of the disc and represented as microscopically encoded depressions called pits. There are roughly 4 to 5 billion pits per disc arranged in a spiral from the inner part of the disc to its outer edge. A reflective coating is applied to this side of the disc. A protective coating goes over the reflective surface.

Information stored on a CD-ROM is read optically without any direct contact with the reflective surface. A narrowly focused laser beam bounces off of the reflective layer and is modulated by the alternation between pit and land surfaces. A photoreceptor converts the reflected light into an electrical signal which is interpreted by the drive electronics as data.

The laser beam diameter is focused from about 1 mm from the front of the disc to about 1/1000 mm into the pit. Under these conditions, a hair or tiny scratch on the disc surface has negligible effect on the data.

The data from premastering is transferred during mastering to a glass master. This is a finely polished glass disc, whose surface is comparable to an astronomical mirror found in quality telescopes. The disc is coated with a light sensitive chemical or photoresist. A special spin-coating process insures that the photoresist forms an absolutely uniform layer about 120 nanometers thick. The thickness of this layer determines the depth of the pits.

The key to the mastering process is the laser beam recorder. It is switched on and off in sequence with the premastered data stream. The modulated laser beam exposes the photosensitive layer on the glass disc. The exposure takes place *in real time* - in a spiral from the inside to the outside of the disc at exactly the same speed and way that the CD-ROM will be replayed.

Next a chemical process is used to create a die or stamper. The glass master is etched in a chemical solution that reveals the exposed areas and produces the first pits. Electronic instruments control the development and automatically halt the process after reaching a prescribed pit depth. The structure of the walls of the pits are also monitored to assure quality.

When the glass master dries, it is coated with a thin layer of silver 100 nanometers thick. After the silver coating, a special disk master player is used to read the data. The production master is thoroughly tested, since its quality affects all subsequent steps. The error detection code can be checked to identify errors that may have been introduced by the mastering process itself.

Quality is ensured only if all processes take place under exacting conditions. The air must be conditioned and very "clean" with not more than 100 particles larger than .5 micrometers per 28 liters allowed. The water used for cleaning the glass discs must be deionized and sterilized, so after this treatment, the water becomes an insulator.

As you might imagine, a glass master disc is too fragile to be used to press the pits into the plastic body of a CD-ROM disc. In the next stage, the glass master is turned into a die or stamper.

An electrolytic bath using a nickel anode changes the silver layer of the glass master to a cathode. As the electrical current is applied, a layer of nickel grows on the glass master. After the nickel layer is separated from the glass master it is known as the original or "father". Since the glass master is destroyed along the way, a new master must be made if there are subsequent quality problems with the father.

The "father" is like a negative, meaning that the pits have been turned into elevations. You can actually duplicate CD-ROMs using the "father". However, to avoid the risk of destroying the original and requiring a costly new master, a second electroplate, the "mother" is produced from the original. The metal stampers ("sons" and "daughters") are then made from the "mother" in a third step.

Like the original, these stampers are also negatives and are used for the actual duplication.

Duplication

Mass duplication of a CD-ROM involves these steps:

- Molding the plastic discs
- Applying the reflective surface
- Affixing the label

A laser must pass through the plastic of a disc twice to read the data. Many highly technical factors affect the choice of plastic material that is used: optical purity, degree of translucence, acceptable refraction index. The material also has to meet certain manufacturing criteria such as a low viscosity at high temperatures to maintain the pit structure. Polycarbonate meets these requirements.

CD-ROM discs can be manufactured using either a mold stamping process or an injection mold process. In mold stamping, the pits are pressed into a newly molded polycarbonate disc. In injection molding, the polycarbonate is heated into the pattern directly. With either process, the cooled polycarbonate disc contains all the data.

The side containing the data is coated with an atomized aluminum to a thickness 40 to 50 nanometer. Coating the disk like this is called *sputtering*.

To protect the aluminum layer against oxidation and other effects, the disc is sealed with lacquer. Its done using spincoating, where the lacquer is dropped into the middle of a spinning disc which lays down a uniform layer about 10 micrometers thick.

After the lacquer hardens, the data has become protected against external effects. Stamping, metallization and protecting are all done under clean-room conditions. All other operations can be performed without additional precautions.

Next, a label is printed on the lacquer layer. There are two common ways to print a label. In the U.S., the preferred method is screen printing, similar to the way custom T-shirts are printed. In Europe, the buffer printing is more widespread. For buffer printing, an ink color is taken from a printing block with a rubber stamp and is transferred to the CD.

Quality control

The demands of a CD-ROM require a higher level of quality control for audio CDs. When an error is detected on an audio CD, the erroneous data can be replaced by interpolation without a perceptible loss in quality. On a CD-ROM each and every bit of information is equally important. So quality control is especially important in CD-ROM production.

As you can tell, quality control isn't a step in the manufacturing process. Instead, it's an integral part of the process. If a bad stamper is made during the mastering step, quality control after the duplication step will only detect a large number of faulty discs. Quality control is working when it prevents or corrects the mistakes made during the mastering step.

During each stage in the manufacturing process, the intermediate results are carefully checked to insure that data integrity has been preserved. Most of the manufacturing steps are performed in a highly conditioned environment to minimize dust particles. High precision optical and electronic monitors check each disc that leaves the production line.

The final check and maybe the most important is the customer test drive of the new CD-ROM. If he can put the CD-ROM into his drive, run the applications from the disc and read the data flawlessly then the manufacturing is successful.

Producing Your Own CDs

You can well imagine that this level of equipment and manufacturing facilities is not affordable to most of us. However, there are alternative ways to make CD-ROM discs. For a few hours work and several thousand dollars, you can make your own discs on a CD-ROM recorder.

Using a recorder is a practical way to produce one or a few copies of a CD-ROM. However, if you need more than a few discs, a CD-ROM recorder isn't a very economical way to produce them. For multiple copies of a CD-ROM, you'll want to have a duplication house make them. For 500 copies, the price per disc is less than $2.00. For 10,000 copies, the price drops to about $1.00. By comparison, the cost of a blank gold disc for a CD-R is about $20 each.

Personal CD-ROM recorders

A CD-R is made using a special device called a CD-ROM recorder or burner. Only a few years ago the price of a CD-ROM recorder was an astronomical $20,000-$25,000. Today, higher demand and more competition and demand have brought the price of recorders to a more palatable level. Some of the newer models are priced as low as $3,000. We've even heard predictions that recorder prices will drop to $1,000 by early 1995. At these prices, personal CD-ROM production is within the reach of many users.

A recorder is attached to your computer through a SCSI interface which accommodates the device's high data transfer rate. This computer system needs to have a lot of horsepower to record a CD-R. For starts, you need a large amount of hard drive space. First, the data to be recorded is copied to a subdirectory on a hard drive. Next the data is premastered to create an image file of CD-ROM. You can see that if the data uses 500 Meg of space and the image file uses 575 Meg of space, you'll need quite a large hard drive.

Burning the image file to the CD-R requires a steady, high transfer rate from the hard drive to the recorder. If the flow of data is interrupted for any reason, either due to slow hard disk access or a read error, the entire recording process may have to be stopped and restarted resulting in a trashed CD blank disc and $20 down the drain. The computer system therefore needs to have a fast processor to maintain the high data transfer requirements of the recorder.

To record the data onto a CD-R disc, you use special premastering software. This software writes an image of the CD-ROM to your hard drive and/or the CD-R recorder. It can make an image of the disc in any of these formats:

- CD-DA
- CD+MIDI
- CD+G
- CD-ROM
- CD-ROM XA
- Photo-CD
- CD-I

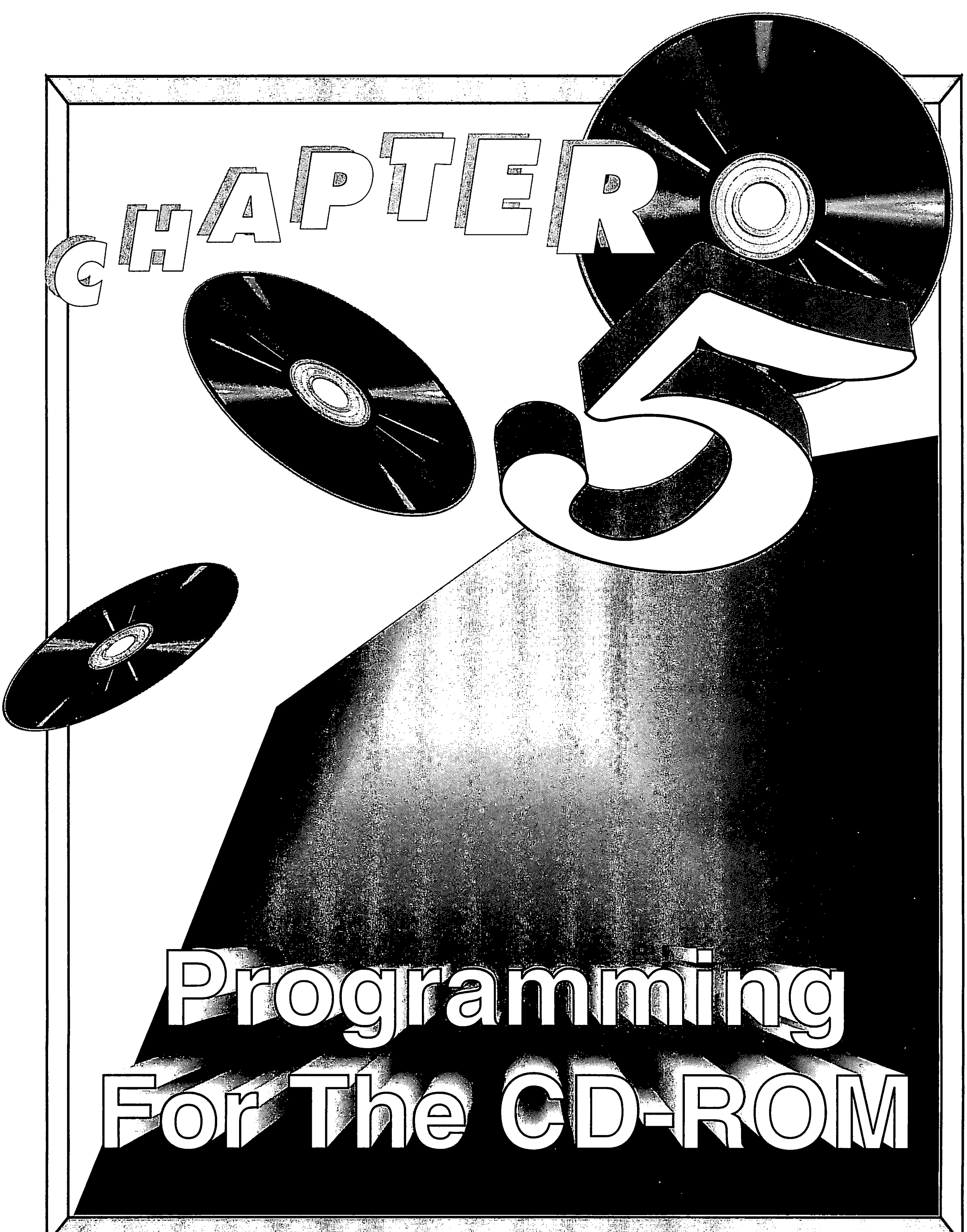
A recorder can also write multiple sessions to a CD-R disc. Since the formatting is performed by the software, if a new format is defined, it's likely that the software can be updated to record it. The exception is CD-V. The video information on these discs is recorded as analog data using different shaped pits. A recorder cannot record data this way.

Some of the more powerful premastering software packages let you simulate the CD-ROM from the hard drive and even edit the disc image to perform last minute changes.

After premastering, the image is written to the disc by the recorder. The time to record the image varies with the speed of the equipment. In general, a 1x speed drive can record a 600 Meg disc in an hour, 2x speed drive in 30 minutes and a 4x speed drive in 15 minutes.

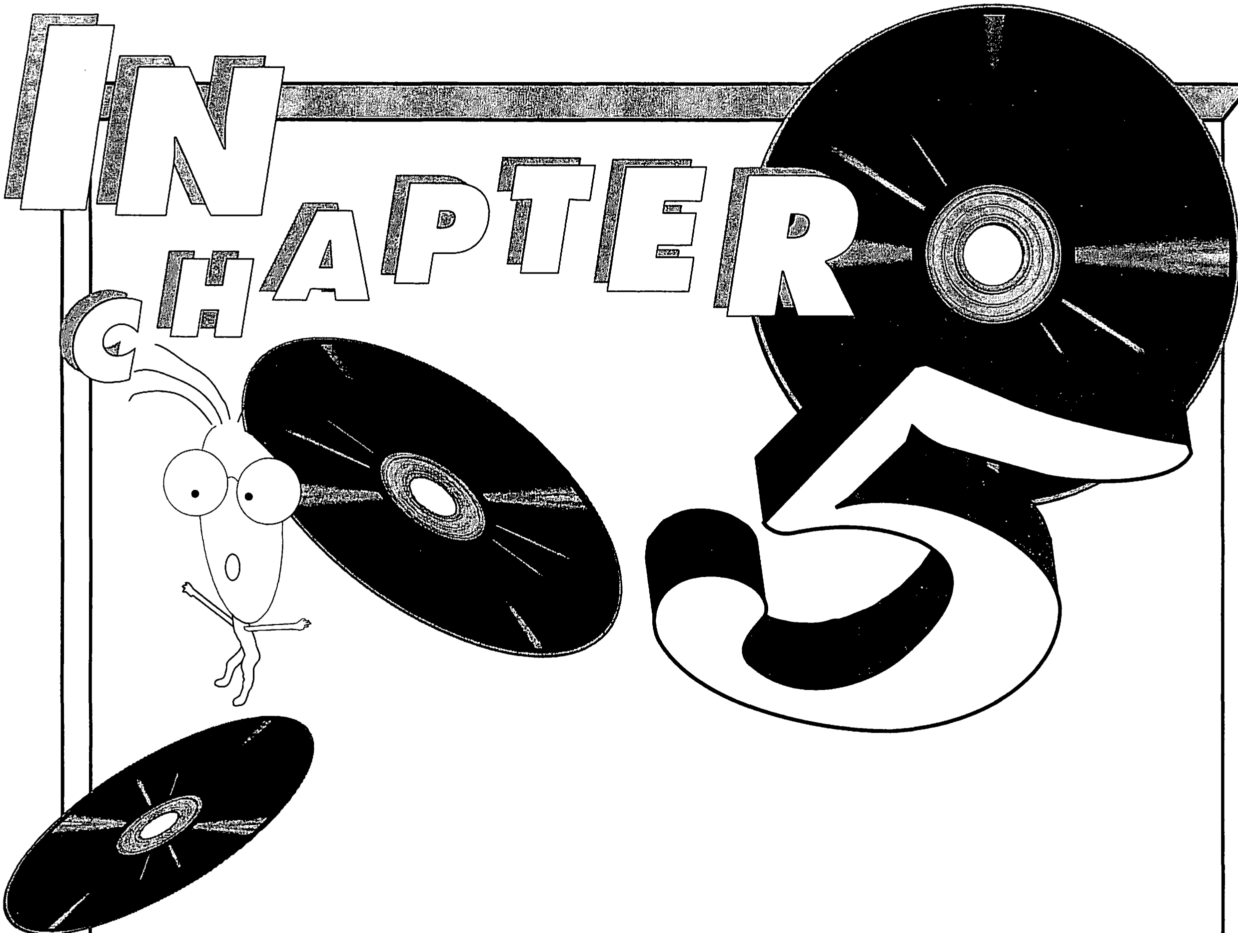
The CD-ROM Writer utility included in CorelSCSI Version 2 lets you write to single or multiple sessions to a CD-R. Some CD-ROM burner manufacturers include software with their equipment such as the RCD-PC software for the Pinnacle Micro recorders.

In short, if you're thinking about CD-R recording, you'd better make sure that your computer system is a screamer with lots of hard disk space.



CHAPTER 5

Programming For The CD-ROM


IN CHAPTER
5

5 Programming For The CD-ROM

For the experienced programmer, there's nothing inherently difficult about CD-ROM programming. As with any new peripheral, there are a few program housekeeping chores that need to be taken care of ahead of time. Some programmers may even find these to be tricky or even frustrating.

All high level languages such as C++ and Pascal are suitable for CD-ROM programming. To access the data on a disc, you have to work your way through a series of functions and subfunctions, especially if you're trying to use some of the more sophisticated techniques such as audio playback.

The goal of this chapter is to provide you with enough information so that you can write a program similar to the sample program on the companion CD-ROM. At the conclusion, you'll be able to address the CD, retrieve the CD-ROM parameters and even playback sound recordings. We assume that you're an experienced programmer and have a working knowledge of C++.

Introduction

Using the Visual C++ language, first we'll see how to address the CD-ROM drive. Even though our example is written in the Visual C++ dialect, it's quite easy to adapt it to other languages. Whenever possible, we've tried to use language independent examples.

One of the best ways to learn programming is by example. As such, many examples are found in this chapter.

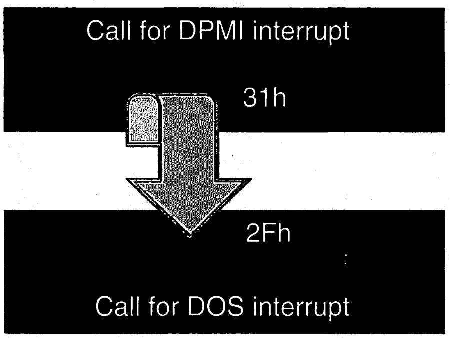
In all the following examples, hexadecimal numbers are indicated by appending the letter "h" to the value. For example, the decimal value 16 is represented in hexadecimal as 10h.

Since this example is a Windows program, all of the explanations are based on the Windows programming environment. Because Windows runs under DOS, we'll also have to discuss some of the underlying DOS functions. In some places, we'll also describe the DOS environment so we can understand the CD-ROM extension to the DOS multiplexer interrupt 2Fh, for example.

Programming For The CD-ROM

Determining The CD-ROM Sector Size

First, let's see how we can determine the sector size of a CD-ROM. This appears like a straight-forward task. Call interrupt 2Fh, function 15h, subfunction 10h and the sector size is returned. Wait a minute! Since we're running under Windows, we don't have direct access to the DOS interrupts.Instead, we'll have to use DPMI interrupt 31h to switch from the Protected Mode of Windows to the Real Mode of DOS. We do this by using function 300h of the DPMI interrupt 31h.



To call a DOS interrupt, you need to call a DPMI interrupt first

Let's program a function called AskSectorSize. It will return either the desired sector size or an error message. The constants, data structures, variables and other functions are declared before this function is defined. Note this portion of the program is compiled in a large model. If we use a small model, some of the addresses may have to be declared explicitly.

First, we define the constants. Two constants are defined to check the return status of subfunction 10h of function 15h of interrupt 2Fh. Another constant defines which CD-ROM drive to be addressed (in our example it's DOS drive label E:).

```
// Constants
#define INTR10_OK           0x0000   // subfunction successful
#define ERROR_STATUS  0xFFFF  // error calling subfunction
#define DRIVE                     0x0004      // CD-ROM drive identifier
                                    // Drive A: 0x0000
                                    // Drive B: 0x0001
                                    // Drive C: 0x0002
                                    // Drive D: 0x0003
                                    // Drive E: 0x0004
                                    // Drive F: 0x0005
                                    // etc.....
```

Next we define the data structures that we'll be using.

1. We define the DPMI structure for using the DPMI interrupt call.
2. We define a Header structure for sending the device request.
3. We define a ReqSize structure for determining the actual sector size.
4. We define a DriverIO structure that we will use to communicate with the IOCTL subfunction of the device requestor.

```
//        Data Structures
typedef struct DPMI
//     DPMI communication structure for switching
//     between "protected mode" and "real mode".
//     Registers are used to transfer value to real mode interrupt
//     Resulting values are passed back to protected mode
{
   DWORD   EDI,
      ESI,
      EBP,
      Dummy1,
      EBX,
      EDX,
      ECX,
      EAX;
   WORD   Flags,
      ES,
      DS,
      FS,
      GS,
      IP,
      CS,
      SP,
      SS;
} s_DPMI;

typedef struct Header
//  Request header structure for interrupt 2Fh, function 15h, subfunction 10h
```

```
//   used for communicating with the MSCDEX CD-ROM driver.
{
   BYTE   Len,                        // complete length of structure is 13 bytes
              SubUnit,                  // sub unit of the device
              CommandCode;            // command number
                                            // "IOCTL input" = 3
   WORD   Status;                     // Return status
   CHAR    Name[8];                 // return buffer
} s_Header;

typedef struct ReqSize
//   Structure for requesting sector size
{
   BYTE   Command;    // Subcommand number
                                   // "read sector size" = 7
   BYTE   Mode;          // "cooked mode" = 0
                                   //  or "raw mode" = 1
   WORD   Size;           // Result, if no error ==> Sector size
 } s_ReqSize;

typedef struct DriverIO
//  Structure for the driver information for interrupt 2Fh, function 15h, subfunction 10h
// IOCTL input = 0 used to communicate with low-level functions of CD-ROM device driver
{
   s_Header   Header;      // "request header"
   BYTE       Descriptor;
   WORD     BufLo,       // Offset and
                   BufHi;       // segment address of ReqSize
    WORD    BufSize;      // buffer length
    DWORD  Start,
                   VolPtr;
} s_DriverIO;      // 13 + 15 = 28 Bytes
```

We need one variable: The DPMI structure.

```
//    Variables
s_DPMI  DPMIVar
```

Now we're ready to program the function.

We start by defining an assembly language function DPMIIntr. This function is used to call the DPMI interrupt. Then we introduce SendDeviceRequest as the interface to MSCDEX. This function is used by the next function IOCTLinput. Finally, we define our function AskSectorSize which will determine the actual sector size of the CD-ROM.

```
//     Functions:
void DPMIIntr (UINT Segm, UINT Offs)
//    Call  DPMI interrupt 31h
//    Simulating "real mode" interrupt 2Fh is hard coded.
//    This function must be coded in assembly language
//    and must not be performed above the interrupt
//    function in the high level language.
{   _asm {
   push   ax
   push   bx
   push   cx
   push   es
   push   di
   mov   di, Offs      // Offset of the address of the transfer  block
   mov   cx, Segm    // segment of the address of the transfer block
   mov   es, cx
   mov   cx, 0          // must be 0
   mov   bx, 0          // must be 0
   mov   bl, 2Fh      // call interrupt 2Fh
   mov   ax, 300h    // Simulate "real mode" interrupt
   int   31h              // initiate DPMI interrupt
   pop   di
   pop   es
   pop   cx
   pop   bx
   pop   ax
      }
}// DPMIIntr

int SendDeviceRequest (void * pReqHeader, UINT BufSize)
//     call subfunction 10h (send device request)
//     of function 15h of  interrupt 2Fh.
{
```

```
      BYTE   far   *pBuffer;
      DWORD      dwBuffer;
      WORD         wSelector,
                          wSegment;
   s_DPMI  far    *pDPMIVar = &DPMIVar;
//   begin
//   Reserve space in DOS memory for "DriverIO":
    dwBuffer = GlobalDosAlloc (BufSize);
     if (dwBuffer == 0)
         {
            AfxMessageBox
              ("ERROR: Cannot allocate DOS memory");
               return -2;
          }
//    dwBuffer now contains the address of the reserved memory area
//     in real mode and  protected mode:
   wSelector = LOWORD (dwBuffer);                  //   protected mode  Selector
   wSegment =  HIWORD (dwBuffer);               //   real mode Segment structure buffer
pointer:
   pBuffer = (BYTE far *)   ((DWORD) wSelector << 16);
//    transfer data from pReqHeader:
   memcpy  (pBuffer, pReqHeader, BufSize);
//    reserve DPMI:
   memset (&DPMIVar, 0, sizeof (s_DPMI));
//    initialize 0
   DPMIVar.EAX = 0x1510;                    //    function 15h, subfunction 10h
   DPMIVar.ES = wSegment;                   //    DOS buffer address for interrupt 2F
   DPMIVar.EBX = 0;
   DPMIVar.ECX = DRIVE;                    //    CD-ROM  drive number
   DPMIVar.SP = 0;
   DPMIVar.SS = 0;
//  Call the DPMI interrupt:
   DPMIIntr (_FP_SEG (pDPMIVar), _FP_OFF (pDPMIVar));
//  transfer data to pReqHeader from the buffer:
memcpy (pReqHeader, pBuffer, BufSize);
//   release reserved DOS memory:
   wSelector = GlobalDosFree (wSelector);
```

```
  if (DPMIVar.Flags & 0x0001)
       return -1;           // Error
  return 0;                 // No Error
}// SendDeviceRequest


DWORD IOCTLinput (void *Req, int Size)
//   Call command 3 "IOCTL input"
//    of the subfunction "send device request"
 {
  CHAR            szMessage[64];
  BYTE   far     *pBuffer;
  DWORD       dwBuffer;
  WORD           wSelector,
                          wSegment;
  WORD            Ret;
//   begin
//   Reserve space in the DOS memory for the transfer buffer:
   dwBuffer = GlobalDosAlloc (Size);
   if (dwBuffer == 0)
   {
       AfxMessageBox
           ("ERROR: DOS memory cannot be reserved!");
        return -2;
    }
//      dwBuffer now contains the address of the reserved
//       memory area in real and protected mode":
   wSelector = LOWORD (dwBuffer);              // protected mode Selector
  wSegment = HIWORD (dwBuffer);           // real mode Segment construct buffer pointer:
   pBuffer = (BYTE far *) ((DWORD) wSelector << 16);
//  transfer contents of Req:
  memcpy (pBuffer, Req, Size);
//  DriverIO call structure:
  memset (pDriverIO, 0, sizeof (s_DriverIO));   // initialize to 0
  DriverIO.Header.Len = sizeof (s_DriverIO);    // buffer length
  DriverIO.Header.CommandCode = 3;              // command 3- IOCTL input
  DriverIO.BufLo = 0;                                        // Transfer ReqSize
```

```
   DriverIO.BufHi = wSegment;                                  // buffer address
   DriverIO.BufSize = Size;                                         // buffer length
//  Call SendDeviceRequest:
if ( SendDeviceRequest (pDriverIO, sizeof (s_DriverIO)))
           {
     wsprintf ( szMessage, "ERROR: Device Driver status 0x%lx", DriverIO.Header.Status);
                       AfxMessageBox (szMessage);
      Ret =  ERROR_STATUS;       // Error
            }
            else
            {
       Ret = INTR10_OK;                      // No Error
// transfer pBuffer contents
                  memcpy (Req, pBuffer, Size);
             }
// Release reserved DOS memory:                     GlobalDosFree (wSelector);
             return Ret;
 }// IOCTLinput
WORD AskSectorSize ()
// Determine the sector size of the CD-ROM.
{
//   begin
   ReqSize.Command = 7;       // "IOCTL input: return sector size"
   ReqSize.Mode    = 0;           // "cooked mode"
   ReqSize.Size     = 0;             // size of sector is returned
//  go get the sector size
if (IOCTLinput ( &ReqSize, sizeof (s_ReqSize)) == INTR10_OK)
            return ReqSize.Size;                                      // No Error
      else
             return;                                                         //Error
}// AskSectorSize
```

You can now call this function from a program:

```
WORD Size = AskSectorSize ();
```

The sample program shows how to access the underlying layers of the Windows multimedia interface. We'll expand on this by introducing the top layer of the Media Control Interface (MCI) with a sample program for using the MCI to playback of wave format files (WAV) through a sound card.

Chapter 5

Programming For The CD-ROM

Real and Protected modes

We'll start by reviewing the basic memory management of the operating system for different processor types. The Intel 80286 processor and its successors (the 80x86 processors) recognize at least two different operating modes.

Real Mode

The operating mode for the original 8088 CPU is called Real Mode. A processor operating in Real Mode can only address the first megabyte of main memory.

Protected Mode

The mode that was introduced with the 80286 is called Protected Mode. A PC in Protected Mode can address much more than 1 Meg of memory.

A program running in Real Mode cannot run in Protected Mode (and the other way around), since the addressing scheme used by the two operating modes are very different.

Operating modes under MS-DOS and Windows

DOS uses the Real Mode of the 80x86 processor. Windows, on the other hand, uses the Protected Mode of the 80x86 processors. Since Windows is based on DOS, there is a mechanism to switch between the two operating modes.

By using this feature, DOS programs that run under Windows are able to address the Protected Mode features of Windows. Likewise, Windows programs are able to address Real Mode features of DOS.

Switching between operating modes - The DPMI Interface

The processor must be switched from Real Mode to Protected Mode to allow DOS addressing of the main memory above 1 Meg. The memory is accessed, and the processor is switched back to Real Mode. The DPMI (DOS Protected Mode Interface) was designed to accommodate the switching between these two operating modes.

In general, DPMI permits communication between programs that run in Protected Mode and programs that run in Real Mode. DPMI functions are carried out using Interrupt 31h.

DPMI is used mainly under Windows to allow Windows programs the access of DOS drivers, DOS interrupts and memory resident programs (TSRs). DPMI also allows Real Mode interrupts to be used by Protected Mode routines (callback). Windows applications should therefore only use the following DPMI functions:

DPMI function	Description
0200h	Return address of the real mode interrupt vector
0201h	Set real mode real mode interrupt handler
0300h	Simulate real mode interrupt
0301h	Call real mode function with "far return" ending
0302h	Call real mode function with "iret" ending
0303h	Request real mode callback address
0304h	Release real mode callback address

Windows provides two additional functions to allocate memory in the DOS area and can be addressed from protected and Real Mode:

```
DWORD GlobalDosAlloc ( wSize )
```

The GlobalDOSAlloc function allocates a buffer of the size wSize in the DOS memory area which is in the lower first megabyte of the main memory. The parameter wSize is a word, that determines the size of the area to be allocated.

It returns a double word value. The higher order of the double word (the top 16-bits) of the return value contains the Protected Mode selector of the address of the reserved memory. The lower part of the double word (the lower 16-bit) contains the Real Mode segment of the address of the reserved memory area.

```
WORD GlobalDosFree (wSelector)
```

This function releases the buffer that was reserved using GlobalDosAlloc Protected Mode address wSelector.

Exchanging information between the operating modes

You can use a predefined data structure to pass information between the real and protected operating modes. This is a Real Mode data structure. Using this structure, a value is stored in each processor register equivalent. The fields are mixed 32-bits (double words) and 16-bits (word). Most information is transferred in 16-bit values which requires the higher part of the double word to be filled with 0.

Register	Description	Size (Bit)	Offset (Byte)
EDI	Extended Data Instruction	32	0
ESI	Extended Source Code Instruction	32	4
EBP	Extended Base Pointer	32	8
-	Reserved	32	12
EBX	Extended BX	32	16
EDX	Extended DX	32	20
ECX	Extended CX	32	24
EAX	Extended AX	32	28
Flags	Flag-Register	16	32
ES	Extra Segment	16	34
DS	Data Segment	16	36
FS	FS-Register	16	38
GS	GS-Register	16	40
IP	Instruction Pointer	6	42
CS	Code segment	6	44
SP	Stack Pointer	6	46
SS	Stack Segment	6	48

For less than 30 words, you can also pass data between operating modes through the DMPI Real Mode stack. To do this, load SS and SP with 0. To transfer more than 30 words, you have to provide your own stack and store its address in SS and SP.

Programming For The CD-ROM

It's important that the segment registers are filled with Real Mode segment addresses and not with Protected Mode descriptors, because the values that are returned in the Real Mode call structure are loaded into the corresponding registers before calling the Real Mode interrupts.

Major DPMI functions

We'll explain the DPMI function on the next few pages. If any function cannot be completed, the carry flag is set to indicate a problem.

DPMI function 0200h

Return the real mode interrupt vector

Register contents for calling interrupt 31h:

AX:	0200h
BL:	31h

Register contents returned

CX:	Segment of real mode interrupt vector
DX:	Offset of real mode inerrupt vector

DPMI-Function 0201h

Set real mode interrupt handler

Register contents for calling interrupt 31h:

AX:	0201h
BL:	31h
CX:	Selector of real mode callback address
DX:	Offset real mode callback address

DPMI-Function 0300h

Simulation real mode interrupt

Register contents for calling interrupt 31h:

AX:	0300h
BL:	31h
DI:	Offset of transfer block's protected mode address
ES:	Selector of transfer blocks's protected mode address

DPMI-Function 0301h

Call real mode function with far return ending

Register contents for calling interrupt 31h:

AX:	0301h
BL:	31h
DI:	Offset of protected mode address of routine
ES:	Selector of protected mode address of routine

DPMI-Function 0302h

Call real mode function with iret return

Register contents for calling interrupt 31h:

AX:	0302h
BL:	31h
DI:	Offset of protected mode address of routine
ES:	Selector of protected mode address of routine

DPMI-Function 0303h

Create real mode callback

Register contents for calling interrupt 31h:

AX:	0303h
BL:	31h
SI:	Offset real mode callback address
DS:	Selector real mode callback address
DI:	Offset protected mode address of routine
ES:	Selector protected mode address of routine

DPMI-Function 0304h

Return real mode callback

Register contents for calling interrupt 31h:

AX:	0304h
BL:	31h
SI:	Offset real mode callback address
DS:	Selector real mode callback address
DI:	Offset of protected mode address of routine
ES:	Selector of protected mode address of routine

MSCDEX driver and the CD-ROM extensions to the Multiplexer Interrupt

The MSCDEX driver provides the DOS interface for DOS for addressing a CD-ROM device. The driver adds function 15h to the multiplexer interrupt 2Fh, which handles the CD-ROM extensions.

The CD-ROM extensions include the following subfunctions:

Subfunction	Description
00	Get number of CD-ROM drives
01	Get CD-ROM drive list
02	Get copyright filename
03	Get abstract filename
04	Get bibliographic filename
05	Read volume table of contents
06	Reserved
07	Reserved
08	Absolute disc read
09	Absolute disc write
0A	Reserved
0B	CD-ROM drive check
0C	Get version of CD-ROM Extensions
0D	Get CD-ROM units
0E	Get or set volume descriptor preference
0F	Get directory entry
10	Send device request
1 - FF	Reserved
SS	48

The function is called by loading the Alt-register with function number 15h and the AL-register with the subfunction number. Then interrupt 2Fh is executed.

The following describes the parameters that are passed to MSCDEX and the values returned. If a function cannot be completed, the carry flag is set to indicate a problem.

Programming For The CD-ROM

MSCDEX-Function 00h

Get number of CD-ROM drives

Register contents for calling interrupt 2Fh:

AH:	15h
AL:	00h

Register contents returned:

BX:	Number of drives
CX:	Number of the first drive

MSCDEX-Function 01h

Get CD-ROM drive list

Register contents for calling interrupt 2Fh:

AH:	15h
AL:	01h
BX:	Offset of buffer address for the list
ES:	Segment of buffer address for the list

The list has the following structure:

```
BYTE   unit number
DWORD   pointer to Device Driver header
```

Register contents returned: NONE - information returned in list buffer

MSCDEX-Function 02h

Get copyright filename

Register contents for calling interrupt 2Fh:

AH:	15h
AL:	02h
CX:	drive number (0=A, 1=B, 2=C, etc.)
BX:	Offset of buffer address
ES:	Segment of buffer address

The file name is copied into the buffer followed by binary 0 (38-bytes)

Register contents returned: NONE - information returned in buffer

MSCDEX-Function 03h

Get abstract filename

Register contents for calling interrupt 2Fh:

AH:	15h
AL:	03h
CX:	Drive number
BX:	Offset of buffer address
ES:	Segment of buffer address

The abstract filename is copied into the buffer followed by binary 0 (38-bytes)

Register contents returned: NONE - information returned in buffer

MSCDEX-Function 04h

Get bibliographic filename

Register contents for calling interrupt 2Fh:

AH:	15h
AL:	04h
CX:	Drive number
BX:	Offset of buffer address
ES:	Segment of buffer address

The bibliographic filename is copied into the buffer followed by binary 0 (38-bytes)

Register contents returned: NONE - information returned in buffer

MSCDEX-Function 05h

Read volume table of contents

Register contents for calling interrupt 2Fh:

AH:	15h
AL:	05h
CX:	Drive number
DX:	Sector index (volume descriptor number, 0...)
BX:	Offset of buffer address
ES:	Segment of buffer address

The volume table of contents is copied to the buffer (2,048 bytes)

Register contents returned:

AX:	type of volume descriptor
	FFh = Terminator
	01h = Standard descriptor
	00h = Non-standard descriptor
CX:	Drive number
DX:	Sector index (volume descriptor number, 0...)

Register contents returned: -

AX:	Error code if carry flag set

MSCDEX-Function 08h

Absolute disc read

Register contents for calling interrupt 2Fh:

AH:	15h
AL:	08h
CX:	Drive number
DX:	Sector count
BX:	Offset of target buffer address
ES:	Segment of target buffer address
	The data is copied into this buffer
SI:	Hi-word of the start sector
DI:	Lo-word of the start sector

Register contents returned: -

AX:	Error code if carry flag set

MSCDEX-Function 09h

Absolute disc write

Register contents and use same as MSCDEX function 08h. Not used for CD-ROM.

MSCDEX-Function 0Bh

CD-ROM drive check

Register contents for calling interrupt 2Fh:

AH:	15h
AL:	0Bh
CX:	Drive number

Register contents returned:

AX:0:	Drive supported by MSCDEX
	not 0: Drive not supported
BX:	Signature: ADADh

MSCDEX-Function 0Ch

Get CD-ROM extensions version

Register contents for calling interrupt 2Fh:

AH:	15h
AL:	0Ch

Register contents returned:

BH:	MSCDEX Version number X
BL:	MSCDEX Version number .XX

MSCDEX-Function 0Dh

Get CD-ROM units

Register contents for calling interrupt 2Fh:

AH:	15h
AL: 0Dh	

Register contents returned:

BX:	Offset of buffer address
ES:	Segment of buffer address

The logical unit code is returned in the buffer (26-byte maximum)

MSCDEX-Function 0Eh

Get or set volume descriptor preference

Register contents for calling interrupt 2Fh:

AH:	15h
AL:	0Eh
BX:	0 = read volume descriptor preference
	1 = set volume descriptor preference
CX:	Drive number
DH:	01h = set primary volume descriptor
	02h = set supplementary volume descriptor
DL:	00h = supplementary volume descriptor preference
	01 =

Register contents returned:

DX:	preference settings (when BX = 0)

MSCDEX-Function 0Fh

Get directory entry

Register contents for calling interrupt 2Fh:

AH:	15h
AL:	0Fh
CX:	Drive number
BX:	Offset of buffer containing pathname
ES:	Segment of buffer containing pathname
DI:	Offset of buffer for directory
SI:	Segment of buffer for directory

The directory information is returned in buffer at SI:DX

Register contents returned:

AX:	Recording format:
	0 = High-Sierra format
	1 = ISO-9660 format

MSCDEX-Function 10h

Get directory entry

Register contents for calling interrupt 2Fh:

AH:	15h
AL:	10h
CX:	Drive number
BX:	Offset of driver request header
ES:	Segment of driver request header

This buffer contains the transfer data structure, the "Requestheader".

Register contents returned: NONE status is returned in the request header -

This subfunction uses a request header data structure to talk with the device driver for the CD-ROM. The format of the request header is:

Label	Content	Size	Offset
rhLength	request header length	1 Byte	0
rhUnit	unit	1 Byte	1
rhFunction:	Function number (hexadecimal)	1 Byte	2
	00: initialize		
	01: media check (block device only)		
	02: build BPB (block devices only)		
	03: IOCTL read		
	04: input (read from device)		
	05: non-destructive input, no wait (character devices only)		
	06: input status (character devices only)		
	07: flush input (character devices only)		
	08: output (write to device)		
	09: output with verify (block devices only)		
	0A: output status (character devices only)		
	0B: flush output (character devices only)		
	0C: IOCTL write		
	0D: open device		
	0E: close device		
	0F: removable media (block devices only)		

Label	Content	Size	Offset
	10: output until busy	32	4
	13: generic IOCTL request	32	8
	17: get drive map (block devices only)	32	12
	18: set drive map (block devices only)	32	16
	19: IOCTL query (starting with DOS 5.0)	32	20
	80: read long	32	24
	82: read long prefetch	32	28
	83: seek	16	32
	84: play audio	16	34
	85: stop audio	16	36
	88: resume audio	16	38
rhStatus	status (return code)	2 Byte	3
rhReserved	Reserved	8 Byte	5

The data structure of the request header is extended depending on the specific function.

Function 00h

Initializing (Init)

This function initializes the DOS device driver. The function always returns an error value after initializing.

Length	Content
1 Byte	Number of drives (always 0)
4 Byte	Address of the driver end
4 Byte	Pointer to BPB field
1 Byte	Device number (block device)

Function 03h

Read (IOCTL read)

This function contains several subcommands for determining the drive parameters and activity. The commands are described in the following paragraph.

Length	Content
1 Byte	Media descriptor from BPB
4 Byte	Pointer to a buffer
2 Byte	Length of the buffer contents in bytes
2 Byte	Start sector
4 Byte	Pointer to volume

Function 07h

Erase input buffer and input request (INPUT FLUSH)

This function instructs the driver to erase the input buffer and cancel all requests for IOCTL input.

This function does extend the request header.

Function 0Ch

Write (IOCTL output, WRITE)

Programming For The CD-ROM

This function is similar in its structure to the Read function. It also contains several subcommands which are described in more detail in the following paragraph.

Extension of the request header	
Length	**Content**
1 Byte	Media descriptor from BPB
4 Byte	Pointer to a buffer
2 Byte	Length of buffer content in bytes
2 Byte	Start sector
4 Byte	Pointer to volume

Function 0Dh

Open device (OPEN DEVICE)

This function informs the driver which program is accessing. It should be the first access step of the program addressing the driver.

The function does not extend the request header.

Function 0Eh

Close device (CLOSE DEVICE)

This function informs the driver which program is terminating the access and should be executed as the last request of the program that addresses the driver.

The function does not extend the request header.

Function 80h

Read long (READ LONG)

This function reads either ECC data (2048 Byte, "cooked") or raw data (2352 Byte, "raw") from the CD.

If the mode is Red Book, the sector entry is a binary value frame:minute:second with frame stored in the lowest byte.

Extension of the request header	
Length	**Content**
1 Byte	Addressing mode (0 = HSG, 1 = Red Book)
4 Byte	Pointer to a buffer
2 Byte	Sector number
4 Byte	Start sector
1 Byte	Read mode (0 = "cooked", 1 = "raw")
1 Byte	Interleave size (size)
1 Byte	Interleave skip (skip)

Function 82h

Read long prefetch (READ LONG PREFETCH)

This function triggers a preventive long read, meaning the driver will prefetch a block. The function is identical to the previous function.

Extension of the request header	
Length	**Content**
1 Byte	Addressing mode (0 = HSG, 1 = Red Book)
4 Byte	Pointer to a buffer
2 Byte	Sector number
4 Byte	Start sector
1 Byte	Read mode (0 = "cooked", 1 = "raw")
1 Byte	Interleave size (size)
1 Byte	Interleave skip (skip)

Function 83h

Sector search (SEEK)

This function positions the read head. The function does not wait for the operation to terminate and can therefore be used to prepare for a read operation.

Length	Content
1 Byte	Addressing mode (0 = HSG, 1 = Red Book)
4 Byte	Pointer to a buffer (is ignored)
2 Byte	Sector number (is ignored)
4 Byte	Start sector

Extension of the request header

Function 84h

Play audio (PLAY AUDIO)

This function begins to read audio data.

Extension of the request header

Length	Content
1 Byte	Addressing mode (0 = HSG, 1 = Red Book)
4 Byte	Start sector
4 Byte	Sector number

Function 85h

Stop audio (STOP AUDIO)

This function stop reading audio data at the current position. Audio playback is terminated if the drive is already stopped.

This function does not extend the request header.

Function 88h
Resume audio (RESUME AUDIO)

This function resumes audio playback from the current position after the playback was stopped using function "STOP AUDIO" above.

This function does not extend the request header.

Subcommands of the function 03h

This paragraph describes the subcommands of function 03h "IOCTL input", the structure and contents of the corresponding buffer.

There are two different methods for addressing a sector. One is to address the sector using a logical block number according to High Sierra (HSG). The other is to address the sector using a Red Book address consisting of "frame", "minute" and "second". The frame value "frame" corresponds to one single sector and is located on the lowest address of the double word to be transferred.

Subcommand 0h
Determine device header address (return address of device header)

Structure of transfer buffer

Length	Content
1 Byte	Subcommand (=0h)
4 Byte	Address of device header

Subcommand 1h
Determine actual position of head (location of head)

Dependent on addressing mode (see function 80h Read long)

Structure of transfer buffer	
Length	Content
1 Byte	Subcommand (=1h)
1 Byte	Addressing mode
4 Byte	head position

Subcommand 3h

Error statistics (not yet implemented)

Subcommand 4h

Determine audio channel information (audio channel info)

This function returns information about how the input channels are assigned to output channels and their respective sound volume.

Structure of transfer buffer	
Length	Content
1 Byte	Subcommand (=4h)
1 Byte	Input channel (0-3) for output channel 0 (left)
1 Byte	Sound volume
1 Byte	Input channel (0-3) for output channel 1 (right)
1 Byte	Sound volume
1 Byte	Input channel (0-3) for output channel 2
1 Byte	Sound volume
1 Byte	Input channel (0-3) for output channel 3
1 Byte	Sound volume

Subcommand 5h

Read device bytes (manufacturer specific) (read drive bytes)

Structure of transfer buffer

Length	Content
1 Byte	Subcommand (=5h)
1 Byte	Number of bytes
128 Byte	Buffer

Subcommand 6h

Determine device status (device status)

This function returns status information about the CD-ROM-drive.

Structure of transfer buffer

Length	Content
1 Byte	Subcommand (=6h)
4 Byte	Device status

The device status has a binary structure:

The device status has a binary structure		
Bit no.	Meaning	
	Bit = 0	Bit = 1
0	Door closed	Door open
1	Door locked	Door not locked
2	cooked mode supported	cooked and raw mode supported
3	Read only	Read and write
4	Data only	Data, audio and video
5	No interleave	Interleave according to ISO-9660
6	Reserved	
7	No command prefetching	command prefetching
8	No manipulation of audio channel	manipulation of audio channel
9	High Sierra addressing	HSG- and red-book adr.
10	Reserved	
11	CD not inserted	CD inserted
12	Audio subchannels not supported	Audio subchannels supported
13-31	Reserved	Device status

Subcommand 7h

Determine sector size (return sector size) / Dependant on addressing mode

Structure of transfer buffer	
Length	Content
1 Byte	Subcommand (=7h)
1 Byte	Read mode (0 = "cooked", 1 = "raw")
2 Byte	Sector size

Subcommand 8h

Determine size of volume (return volume size)

This function returns the number of sectors that are determined from the "lead out"-track in the volume directory (TOC).

Length	Content
1 Byte	Subcommand (=8h)
4 Byte	Volume size

Subcommand 9h

Check for media change (media changed)

This function checks for a change in media. Not every drive is able to recognize this automatically.

Length	Content
1 Byte	Subcommand (=9h)
1 Byte	Media byte:
	FFh = changed
	01h = unchanged
	00h = no change recognized

Subcommand Ah

Audio CD information (audio disc info)

This function returns information about the audio data on the CD over the volume directory (TOC).

Structure of transfer buffer	
Length	Content
1 Byte	Subcommand (=Ah)
1 Byte	Smallest track number
1 Byte	Largest track number
4 Byte	Number of the lead out track

Subcommand Bh

Audio track information (audio track info)

This function returns control information about a track. The returned track number is converted to a red-book address.

Structure of transfer buffer	
Length	Content
1 Byte	Subcommand (=Bh)
1 Byte	Track number
4 Byte	Start address of the track
1 Byte	Track information:

The lower 4 bits (Lo-Nibble, Address-Nibble) contain the start address of the track.

The higher 4 bits (Hi-Nibble, Control-Nibble) contain the control information for this track:

Bitmask meaning	Content
??0?	Digital duplication not allowed
??1?	Digital duplication allowed
00?0	2 Audio channels without preemptive phase
00?1	2 Audio channels with preemptive phase
01?0	Data spur
01?1	Reserved
10?0	4 Audio channels without preemptive phase
10?1	4 Audio channels with preemptive phase
11??	Reserved
1 Byte	Track information:

Subcommand Ch

Determine actual position of head (audio Q-channel info)

This function determines the actual position of the drive head. The driver converts the position from the BCD-format to binary if the address-nibble = 0001; otherwise the position remains in the original format.

Structure of transfer buffer	
Length	Content
1 Byte	Subcommand (=Ch)
1 Byte	Track information (control- and address-nibble, see subcommand 0Bh)
1 Byte	Track number
1 Byte	Index
1 Byte	Minute (minute), time relative to the start of the track
1 Byte	Second (second), time relative to the start of the track
1 Byte	Frame (frame), time relative to the start of the track
1 Byte	Null point
1 Byte	Minute (minute), time relative to the start of the CD
1 Byte	Second (second), time relative to the start of the CD
1 Byte	Frame (frame), time relative to the start of the CD

Subcommand Dh

Audio subchannel information (audio sub-channel info)

This function returns the subchannel information of the indicated range using the audio data on the CD through the volume directory (TOC).

Structure of transfer buffer	
Length	Content
1 Byte	Subcommand (=Dh)
4 Byte	Start sector (red-book address)
4 Byte	Pointer for subchannel information buffer.
	96 bytes have to be provided per sector.
4 Byte	Sector number
1 Byte	Frame (frame), time relative to the start of the CD

Subcommand Eh

Determine product code (UPC code)

This function returns the UPC or EAN code of the CD or the error number 8 (sector not found).

Structure of transfer buffer	
Length	Content
1 Byte	Subcommand (=Eh)
1 Byte	Track information (control- and address-Nibble, see subcommand 0Bh)
7 Byte	Product code
1 Byte	Frame (frame), time relative to the start of the CD
1 Byte	Null point

Subcommand Fh

Audio status information (audio status info)

This function returns the head position of the last playback (red book). The return values correspond to values the driver would need for a call of the function "RESUME AUDIO".

Structure of transfer buffer	
Length	Content
1 Byte	Subcommand (=Fh)
2 Byte	Audio status
	Bit 0 = 0: No pause
	Bit 0 = 1: Pause
4 Byte	Start at the last call of "PLAY AUDIO"
	or "RESUME AUDIO"
4 Byte	End with the last call of "STOP AUDIO"

The subcommands for function 0Ch "IOCTL output", the structure and contents of the corresponding transfer buffers follow:

Subcommand 0h

Eject CD (eject disc)

The drive door is unlocked and the CD is ejected, if the hardware supports this function.

Structure of transfer buffer	
Length	Content
1 Byte	Subcommand (=0h)

Subcommand 1h

Lock or unlock drive door (lock/unlock door)

The drive door is locked or unlocked, if the hardware supports this function.

Structure of transfer buffer	
Length	Content
1 Byte	Subcommand (=1h)
1 Byte	= 0: unlock door
	= 1: lock door

Subcommand 2h

Initialize drive (reset drive)

This function initiates a reset of the device driver and therefore also a new initialize of the drive.

1 Byte	Subcommand (=2h)

Subcommand 3h

Audio channel control (audio channel control)

This function determines the assignment of input to output channels as well as the corresponding actual sound volume.

Structure of transfer buffer	
Length	Content
1 Byte	Subcommand (=3h)
1 Byte	Input channel (0-3) for output channel 0 (left)
1 Byte	Sound volume
1 Byte	Input channel (0-3) for output channel 1 (right)
1 Byte	Sound volume
1 Byte	Input channel (0-3) for output channel 2
1 Byte	Sound volume
1 Byte	Input channel (0-3) for output channel 3
1 Byte	Sound volume

Subcommand 4h

Write device control data (write device control string)

Counter part to the "IOCTL input" subcommand 5h, read device bytes (only for manufacturer)

Structure of transfer buffer	
Length	Content
1 Byte	Subcommand (=4h)
1 Byte	Number of bytes
??? Byte	Buffer

The buffer contains the data that is supposed to be transferred directly to the device driver.

Subcommand 5h

Close tray (close tray)

Counter part to eject CD. The CD tray is pulled in and the drive door locked if the function is supported by the hardware.

Structure of transfer buffer	
Length	Content
1 Byte Subcommand (=5h)	1 Byte Subcommand (=5h)

After accessing the separate functions of the DOS device drivers using function number rhFunction, the status word rhStatus returns a state and if necessary any error information.

Structure of rhStatus	
Bit	Meaning
15	Error detected
14 - 10	Reserved
9	Busy (device is in use, e.g. audio CD is running)
8	Done (action finished)
7 - 0	Error number

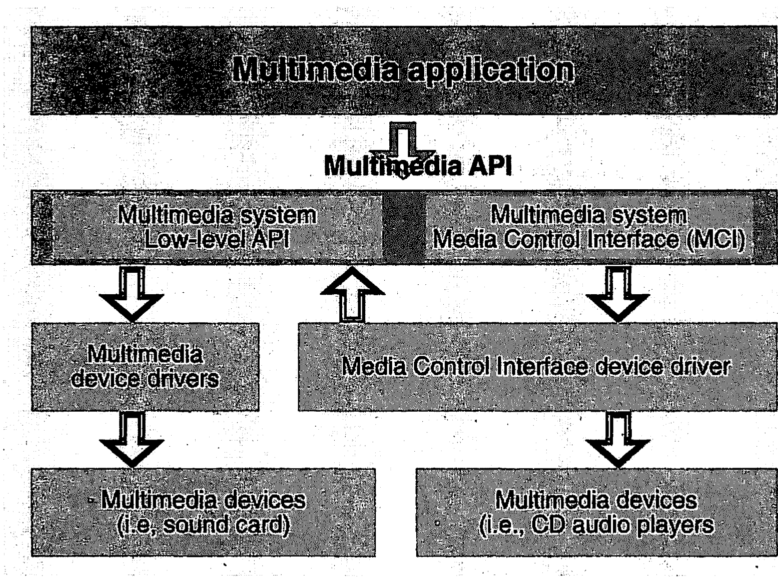
The following is a list of error numbers and their meaning:

Number	Description	Number	Description
0h	Write protection error	8h	Sector not found
1h	Drive unkown	9h	No more paper
2h	Drive not ready	Ah	Write error
3h	Invalid command	Bh	Read error
4h	CRC error	Ch	General error
5h	Request header length invalid	Dh	Reserved
6h	Seek error	Eh	Medium is missing (e.g. CD not inserted)
7h	Medium unknown	Fh	Invalid disk change

The Windows Multimedia-API

Windows includes an extensive Application Programming Interface. The API is a collection of definitions, declarations and functions which an application uses to communicate with Windows. High level languages can use these interfaces to develop Windows programs. Those elements of the interface that support audio, video, CD-ROM and similar devices is called the Multimedia-API.

The API



As you can see from the above illustration, the Multimedia-API is separated into different layers. An application program "talks" to the multimedia devices either through the media control interface (MCI) or through the low level functions of the device. The MCI itself uses the MCI device drivers, which control the hardware, or it controls the hardware on its own using the low level multimedia API.

The Media Control Interface (MCI)

The Media Control Interface (MCI) is a device independent interface for addressing multimedia devices.

There are two programming interfaces:

- The command-string interface
- The command-message interface

The following program examples are written in Microsoft Visual C++. These programs show you more details on using these interfaces.

The following MCI devices can be addressed:

Device name	Device type constant	Description
animation	MCI_DEVTYPE_ANIMATION	Animation device
cdaudio	MCI_DEVTYPE_CD_AUDIO	CD-ROM drive or audio-CD player
dat	MCI_DEVTYPE_DAT	Digital audio tape player
digitalvideo	MCI_DEVTYPE_DIGITAL_VIDEO	Digital video in one window
other	MCI_DEVTYPE_OTHER	undefined MCI device
overlay	MCI_DEVTYPE_OVERLAY	Overlay device (Anlog video in one window
scanner	MCI_DEVTYPE_SCANNER	Image scanner
sequencer	MCI_DEVTYPE_SEQUENCER	MIDI sequencer
vcr	MCI_DEVTYPE_VIDEOTAPE	Video tape recorder or player
videodisc	MCI_DEVTYPE_VIDEODISC	Video discette player
waveaudio	MCI_DEVTYPE_WAVEFORM_AUDIO	Audio device that plays digitalized wave files (i.e., sound card)

Command string interface

As its name suggests, you use strings to communicate with multimedia devices using the command-string interface. The following table summarizes the most important commands:

Command string	Description
capability	Requests information about the abilities of a device.
close	Closes a device after its use.
info	Requests information about a device (description of the hardware connected to this device).
open	Opens and initializes a device to make it ready for use.
pause	Pauses the playback or recording on a device.
play	Starts the playback on a device.
record	Starts the recording on a device.
resume	Resumes the playback or recording on a device that was paused.
seek	Changes the actual position within a medium.
set	Alters the control setting of a device, e.g. time format to be used.
status	Requests information about the state of a device, e.g. device is running or paused.
stop	Terminates playback or recording on a device.

The command strings are transferred to windows using this function:

```
DWORD mciSendString    (    lpstrCommand, lpstrRtnString,
                            wRtnLength,    hCallback       )
```

The following table defines the parameters used by this function:

lpstrCommand	far pointer to a string terminated by zero containing the MCI command string
lpstrRtnString	far pointer to a buffer provied by the application program for returning results. Pointer is 0 if no return text wanted.
wRtnLength	Specifies the size of the above buffer.
hCallback	Handle to the window for processing MM_MCINOTIFY message.

Command message interface

The command-message interface lets you communicate with multimedia devices using messages. A command message consists of three parts:

1. A constant specifying the command
2. Flags specifying the options and to declare as valid or invalid fields in the parameter block
3. A parameter block containing additional command parameters

A command message is passed to Windows with this function:

```
DWORD mciSendCommand ( wDeviceID, wMessage, dwParam1, dwParam2 )
```

The following table defines the parameters for this function:

wDeviceID	WORD parameter (UINT) identifies the MCI device to receive the message. wDeviceID must be used if the device is opened.
wMessage	WORD parameter (UINT) specifies the message.
dwParam1	DWORD parameter specifies the flags for the command. The flags determine which options are used for the command and which fields of the parameter lock are valid.
dwParam2	DWORD parameter contains a pointer to the parameter block. 0 parameter block is not used.

The following table summarizes the major commands:

MCI_GETDEV	Requests information about device capabilities
MCI_CLOSE	Closes a device
MCI_INFO	Requests information about a device (description of the hardware connected to the device)
MCI_OPEN	Opens and prepares a device for use
MCI_PAUSE	Pauses the playback or recording of a device
MCI_PLAY	Starts the playback on a device
MCI_RECO	Starts the recording on a device

DWORD mciSendCommand commands continued	
MCI_RESUME	Resumes the playback or recording on a device that was paused
MCI_SEEK	Repositions the medium
MCI_SET	Changes the control settings of a device, e.g. time format to be used
MCI_STATUS	Requests information about the state of a device, e.g. device is running or paused
MCI_STOP	Terminates playback or recording on a device

Playing A WAVE File Using MCI Control

In the following Visual C++ program example, we'll playback a wave format file through a sound card to show you how the command message interface is used to communicate with Windows.

The program makes a few assumptions:

- The driver for the sound card is installed and is compatible with Windows.
- The name of the wave file to playback is SCHUBIDU.WAV.
- The wave file is located on the hard drive C: in the subdirectory \SOUND.

Our approach is to define a function that can be called with a filename parameter. This parameter is the name of the wave file to be played. The function uses three of the commands: MCI_OPEN, MCI_PLAY and MCI_CLOSE.

MCI_OPEN requires a parameter block, so we define the data structure MCI_OPEN_PARMS:

```
typedef struct MCI_OPEN_PARMS      //Parameter block for MCI_OPEN
{
   DWORD   dwCallback;   // Callback address for the communicating with the application
   UINT       wDeviceID    //  Identifer the device to be addressed
   UINT        wReserved
   LPCSTR    lptstrDeviceType    // device type
   LPCSTR    lptstrElementName  // device element
   LPCSTR    lptstrAlias              //  alternate name for the device
} s_MCI_OPEN_PARMS;
```

We need a second parameter block for using MCI_PLAY so we define the data structure MCI_PLAY_PARMS:

```
typedef struct MCI_PLAY_PARMS  //Parameter block for MCI_PLAY
{
   DWORD   dwCallback;    // Callback address for communicating with the applicationwe
   DWORD   dwFrom         // Starting position for the playback
   DWORD   dwTo             // Ending position for the playback
} s_MCI_PLAY_PARMS;
```

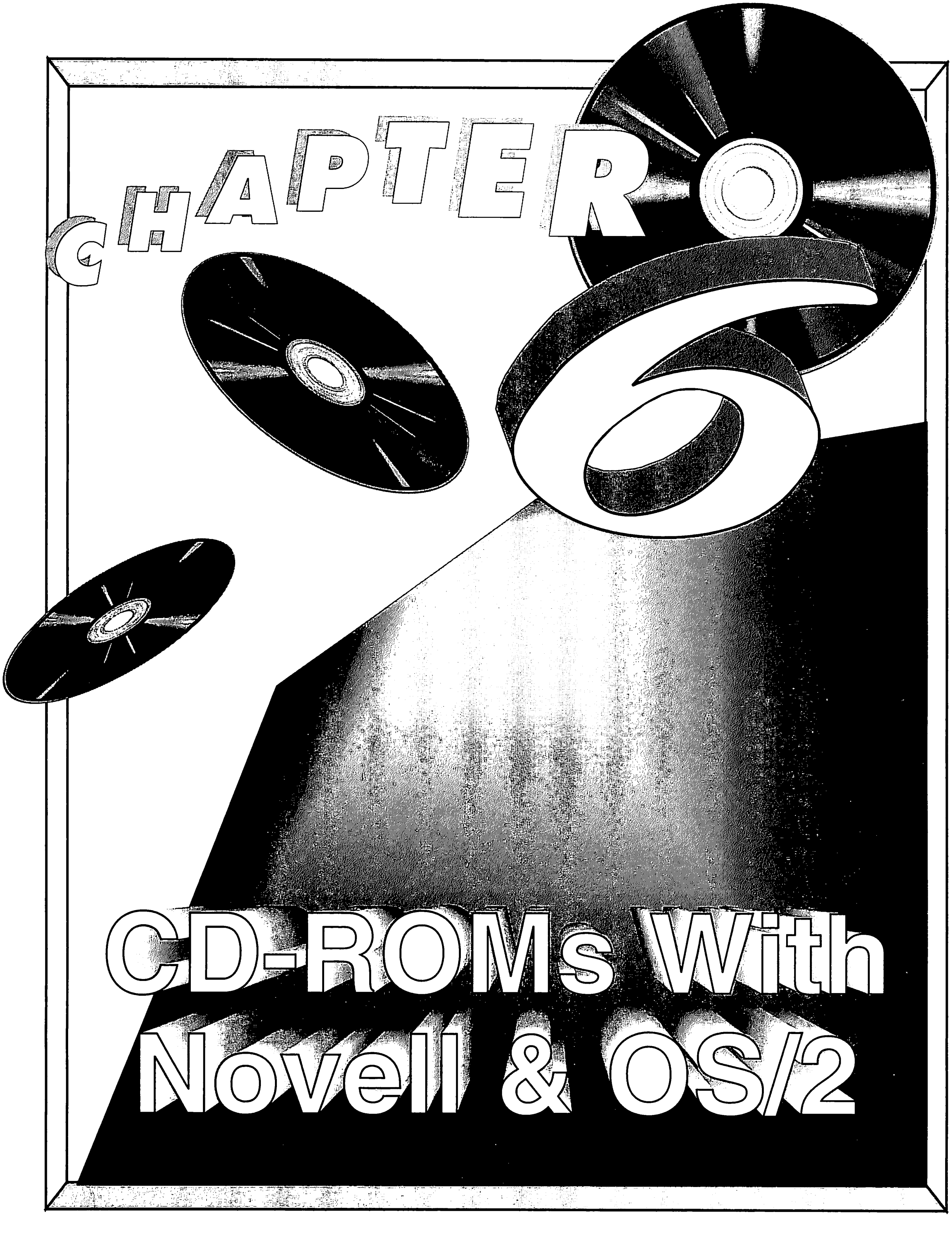
The housekeeping is completed. Now we define the function PlayWaveFile:

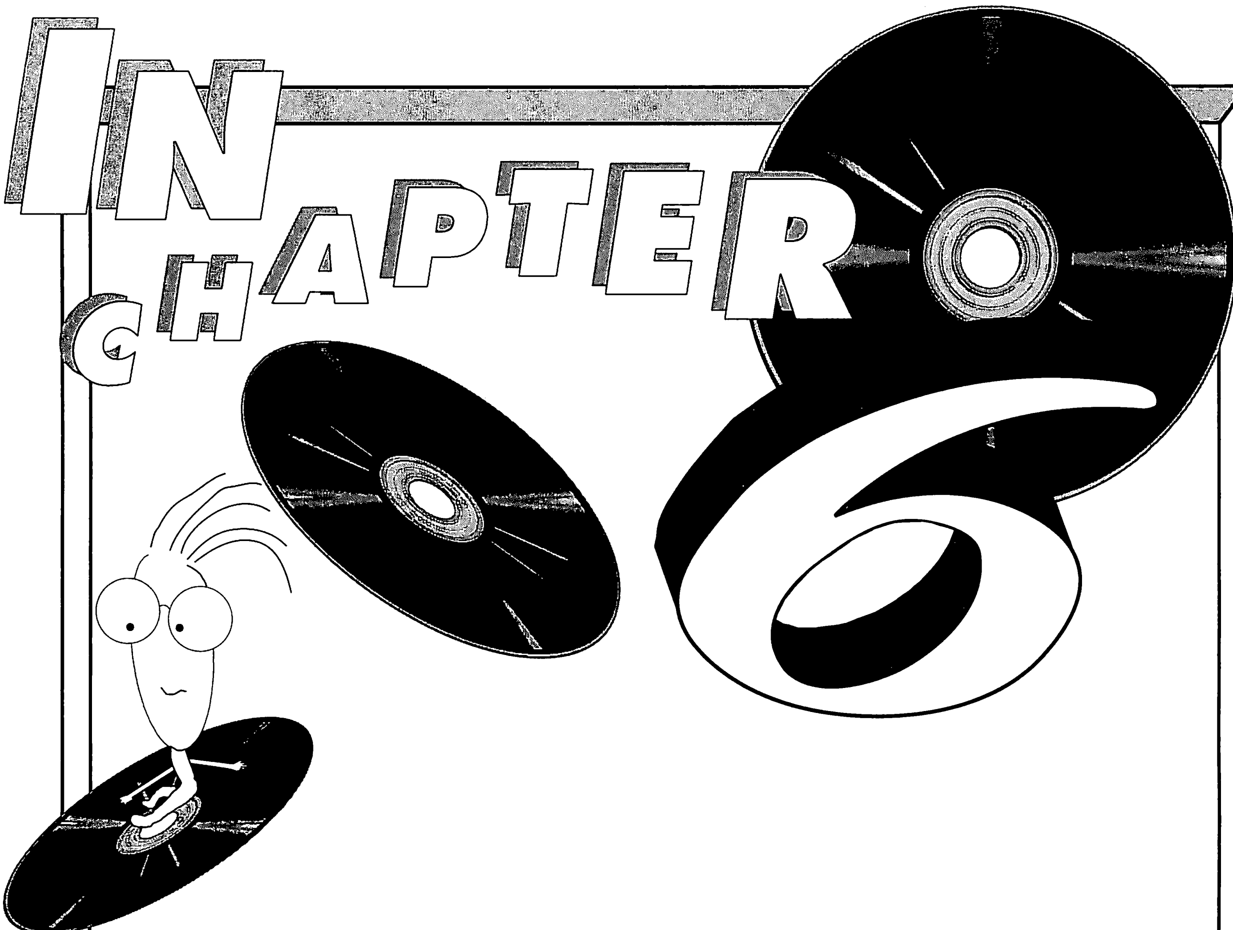
```
DWORD PlayWaveFile (HWND hWndNotify, LPSTR lpstrWaveFilename)
//   Start the playback of wave format file > lpstrWaveFilename.
// The return value is 0 if the playback starts, otherwise  an error number is returned.
{
// Variables
   UNIT        wDeviceID;    // device ID
   DWORD   dwReturn;      // return status
   s_MCI_OPEN_PARMS mciOpenParms;    // MCI_OPEN Parameter block
   s_MCI_PLAY_PARMS mciPlayParms;      // MCI_PLAY Parameter block
//  Initialization
   mciOpenParms.lpstrDeviceType  = "waveaudio";
   mciOpenParms.lpstrElementName = lpstrWaveFilename;
// MCI chooses a device that is able to playback
// wave format data. In our case it's the sound card.
// Open the appropriate device
   if (dwReturn = mciSendCommand (0, MCI_OPEN, MCI_OPEN_TYPE | MCI_OPEN_ELEMENT, (DWORD)
(LPVOID) &mciOpenParms))
   {
     // error while opening the device
      return (dwReturn)
    }
// Device was opened. Device Id is determined.
   wDeviceID = mciOpenParms.wDeviceID;
// Start the playback. Notify the application window when
// playback terminates so the device can be closed.
   mciPlayParms.dwCallback = (DWORD) hWndNotify;
```

```
    if (dwReturn = mciSendCommand (wDeviceID, MCI_PLAY, MCI_NOTIFY, (DWORD) (LPVOID)
&mciPlayParms) )
   {
   mciSendCommand (dwDeviceID, MCI_CLOSE, 0, NULL );
    return (dwReturn)
    }
   return (0);
} // PlayWaveFile
```

You can now call this function from within a program. The calling application has to provide the Windows handle HandleNotifyCallback of type hWnd. Visual C++ provides this type as well as the functions needed to get the appropriate handle for the calling window (see Microsoft Foundation Class Library).

```
DWORD Status = PlayWaveFile (   HandleNotifyCallback, "C:\SOUND\SCHUBIDU.WAV"   );
```


CHAPTER 6
CD-ROMs With Novell & OS/2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CHAPTER
6

6 CD-ROMs With Novell & OS/2

The information in this chapter is important if you're interested in installing and using your CD-ROM drive in different computers or operating systems. In this chapter we'll use NetWare 3.11 and 4.0x operating systems:

Before we discuss installing your CD-ROM drive in the various systems, we'll first provide basic information regarding how a CD-ROM drive operates in all systems. We're assuming that each of the following installation examples follows the SCSI standard since it's basic to all CD-ROM drives. We have however, briefly included additional interface architectures in the various sections of this chapter.

The appropriate interface for the operation of a CD-ROM disk drive

The question of which CD-ROM disk drive is more appropriate for a particular, or different, operating systems depends on the function and the interface to be used. There are basically two standards, (IDE and SCSI), from which you can choose. In addition to its low cost, the IDE standard is preferred because of its ability to use optical drives in the various operating systems. The newer operating systems, i.e., Windows NT and OS/2 2.1, support SCSI drives. Equivalent drivers for the most commonly used SCSI controllers and disk drives are included so the installation of optical SCSI disk drives usually isn't a problem.

When you install an optical drive containing IDE controllers, it's important to note that the IDE drive must be connected to a specific controller. This is not the case with SCSI drives since a SCSI drive can be used with any controller and model type. Therefore, an optical SCSI drive can be run with any SCSI controller while the IDE drive requires a particular model controller. This features allows you to connect hard drives

and optical drives together to a controller in which the IDE is present. The disadvantage of this approach is that any additional computer slots, which might eventually be needed for other tasks, are no longer available.

The importance of optical volumes

The method of reading and writing data on an optical drive on different operating systems is fairly identical. However, there are differences regarding the file system, how the data is stored or how it's organized into categories and subcategories.

To introduce you to the following sections, which describe operating CD-ROM drives under two different operating systems. Optical data carriers conform to the standards established by the International Standardization Organization (ISO). For example, CDs conform to the ISO 9660 standard, which defines the recording format, i.e., the file system, and the data organization on a CD. This gives CDs the ability to be read system wide. This makes it possible, for example, to combine programs and data from different systems on a CD program. These can be read by DOS, Windows, UNIX, and by other systems, such as Apple Macintosh. Also network operating systems, for example Novell NetWare, are able to access CD data directly. The predecessor for ISO 9660 is the High Sierra standard named after the hotel where the conference was held to create the standard.

The ISO standard 10089 concerns reusable optical plates (records), such as would be used in a magnetic optical (MO) drive. The use of such information media is becoming more popular due to the need of larger volumes of data. For example, NetWare 4.01 offers the ability to export data from the hard drive to a MO disk drive, or a MO jukebox . The MO technology uses this drive as a storage device or as a data backup medium. Many users consider the WORM drives with the single use WORM records (Write Once Read Many) to be less suitable for the task, however, they're used today as a backup medium for business records or other files which cannot be changed after being stored.

The NetWare 3.11 CD-ROM

You can install two different types of NetWare 3.11 CD-ROMs. The first type is connecting a CD-ROM drive directly to a NetWare server. This type allows users on the network to access the CD-ROM drive so the CD-ROM is considered like a hard drive (volume). It's available to the user with a Read Only Access limitation or with a limited ability to modify optical volumes.

The second type of NetWare 3.11 CD-ROM you can install is at a workstation. You can then configure it as a dedicated or nondedicated CD-ROM server by using special software. As a nondedicated CD-ROM server, the user of the workstation can work simultaneously at the station the server program is

running on. This is impossible with a dedicated CD-ROM server where the server program terminates and prevents access to any additional activities. You'll need to consider whether it is practical to use the CD-ROM server simultaneously as a workstation or if you want to prefer safety and speed by running the CD-ROM server dedicated.

The necessary software for installing a CD-ROM server is not included with NetWare 3.11. This software is usually available from third party vendors such as Comware. Also, we will not discuss this software individually because of the similarities to NetWare Version 4.0x. You'll need to contact your dealer for more information.

Adding CD-ROM Drives Using Novell NetWare 4.0x

NetWare 4.0x CD-ROM drive support is already integrated in the network operating system. However, this support only applies to drives which are connected to a SCSI controller. Although you may be able to use the available drivers with IDE or other line connections, we're limiting our discussion to the SCSI technology since it is the most popular and the other techniques are of limited importance in network use.

An important feature of a network is the ability to share resources and files so individual systems or files are available to all users in the entire network. This feature simplifies network management and usually saves money. Since hard drives and CDs have different data formats, the network operating system of NetWare 4.0x assigns separate control for CD access. This depends primarily on the hard drive operations.

We'll provide information on how to install and run a CD-ROM drive so you can provide network access to an installed volume. We'll use a NEC CD Express Drive from NEC for this purpose. We cannot provide detailed information on all the performance possibilities of the NetWare 4.0x network operating system in this book. Instead, we recommend that you refer to books specifically written for NetWare to add to the information we provide.

A CD as NetWare volume

The hard drives of a NetWare 4.0x server are organized logically. First, a section or the entire hard drive is reserved for NetWare use when a NetWare partition is created.

Reserved hard drive storage is assigned logical units to the NetWare volumes through NetWare partitions. Although only one NetWare partition is created for every hard drive, this partition can be subdivided into to many volumes. However, it's also possible to attach many NetWare partitions to a

logical NetWare volume throughout the entire hard drive. The control and access to data occurs over the established volumes, which are assigned a letter of the alphabet from the drive at the workstations. Data access can now take place on such a virtual drive.

NetWare must also have control of the CD-ROM Storage medium. It makes no difference to the workstations if a hard drive or a CD is accessed because they both have the organization structure of a NetWare volume as their basis.

Installation of the driver

As we mentioned, CD-ROM drives with SCSI connections dominate in networks with Novell NetWare simply from a practical standpoint. Basically, an optional SCSI controller can be used for the optical drive, providing that a driver is available for Novell NetWare 4.0x. SCSI controllers allow connections for up to seven devices. It also allows the use of SCSI components in a file server. This is not a prerequisite, since SCSI and IDE controllers may be installed at the same time.

The following explanations apply to a fully installed NetWare 4.0x file server. The necessary steps for integrating a CD-ROM drive with the server are of course considered when installing the server. In both cases, you can use the installation module from NetWare 4.0x so the procedures are virtually the same. After connecting the CD-ROM drive to the server SCSI controller, you can turn on the server to complete the installation. A cold start of the PC usually is enough when following the prerequisites from the installation program. You'll find the necessary commands in the AUTOEXEC.BAT batch file which is automatically executed every time you start your PC.

If the server is started with a boot diskette, place it in the boot drive and start up the computer after connecting the drive. If necessary, you can use the system administrator. If the server does not start up independently after a new start of the computer's server, you must control this manually by running the SERVER.EXE server program. Since the server is usually started from a DOS start partition, you'll find the SERVER.EXE program in the C:\SERVER.40 directory.

The C:\SERVER.40 directory must contain the SERVER.EXE program, the SCSI controller driver and the CD-ROM driver must also be stored in this directory.

Since the NetWare 4.0x software is available on a CD-ROM containing the SCSI and CD-ROM drivers, access to the NetWare CD will eventually follow. Make certain that DOS responds to the CD-ROM as a virtual drive.

After you turn on the computer, start the server by typing:

```
CD\SERVER.40
SERVER
```

After the initialization of the NetWare 4.0x server is complete, load the installation module by typing:

```
LOAD INSTALL [Enter]
```

From the **Select an Installation Method** menu, use the cursor keys to move the cursor to the **Maintenance/Selective Install** menu command and press [Enter]. Next, select **Disk Driver Options** from the Installation Options.

You'll see a list of several hard drive controller drivers which are supported by the NetWare 4.0x server. If you cannot find the appropriate entry for your controller, you may add other controller drivers to this list by pressing [Ins] and copy it from the NetWare CD, a manufacturer's diskette or use another path. The CD-ROM must respond to DOS drive letters for access to the CD. The default path is set to the A drive. You may change this by pressing [F3].

When you have found the correct SCSI controller driver for your system, move the cursor to the corresponding line entry and press [Enter]. If the list is expanded with [Ins] and the selected driver cannot be found in the server starting directory, according to the C:\SERVER.40 default, you're prompted if the driver in this menu should be copied. After successfully selecting the driver, you'll be prompted to set the hardware parameters. These parameters must conform to the controller's hardware configuration. You confirm your entries with [F10]. When making your selection, remember CD-ROM support is only available to ASPI compatible drivers.

After the SCSI driver has been successfully installed for the controller, you must install the driver for the CD-ROM support. You have two driver modules with NetWare 4.0x from which to select:

- ASPICD.DSK
- CDNASPI.DSK

You can select either module since both serve the same purpose; only the chosen parameters are different. Load the CD driver module as you did with the SCSI controller driver.

After you install both drivers successfully, press the [Esc] key to return to the **Installation Options** menu. You can be certain the selected driver modules will be activated when starting the system once again. For this, choose the **NCF Files Options** command. Next, select **Create STARTUP.NCF FILE** from the menu that appears. Press [Enter] to accept the default path for this file.

Two text windows (Old STARTUP.NCF-FILE and New STARTUP.NCF-FILE) will now appear. The STARTUP.NCF file is run as a stack when the server is started. Besides other functions, it's designed especially for loading hard drive drivers. The New STARTUP.NCF-FILE window lists the loading instructions for the previously selected SCSI and ASPI-CD-ROM drives and their configuration parameters.

You can save the STARTUP.NCF file, which is automatically generated by the system, by pressing the Esc key and answer the save question. However, note it's possible to overwrite lines that had previously been saved in the old STARTUP.NCF file. If you believe this occurred, you can compare both text windows.

If you don't expect any unintentional information loss, highlight the lines for the SCSI and CD-ROM driver to load and press Esc to return to the previous menu. Then select the **Edit STARTUP.NCF file** command. Insert the previously highlighted lines in the editor window which should now be open, press Esc and answer yes to the save prompt.

The necessary drivers for the operation of a CD-ROM drive have now been activated and will automatically be loaded when starting the system. You therefore do not need to repeat this procedure.

The CD-ROM support module

Since the recording format of a CD is different from that of a hard drive and of a magnetic optical drive, the NetWare 4.0x network operating system also includes a loadable module to consider these differences and is open to the operations of the CD-ROM drive. Type the following command on the server console:

```
LOAD CDROM Enter
```

to activate the CDROM.NLM loadable module (NLM) and, consequently, the CD-ROM support. Note that access to a CD-ROM drive with the CD-ROM module is possible only if the controller driver and the CD-ROM driver have been installed according to the instructions we discussed above.

```
NOVELL40: LOAD CDROM
Loading Module CDROM.NLM
 Netware 4.xx ISO-9660 and High Sierra CD-Rom Support Module
 Version 4.02   June 28, 1993
 Copyright 1993 Novell, Inc. All rights reserved.

8-23-94 9:56:00 am: SERVER-4.0-1355
    Device # 1 NEC CD-ROM DRIVE:25 (5D000000) deactivated due to media
    dismount

For CD-ROM Support HELP enter 'cd help' on the command line.
```

If you want the CDROM.NLM module to be automatically loaded after every server start-up, you must make an entry in the AUTOEXEC.NCF server reserve file. The installation module can be used for this purpose. To start this module, type:

```
LOAD INSTALL Enter
```

Now, move the cursor to the **Maintenance/Selective Install** menu command and press Enter. Select the NCF file options and Edit AUTOEXEC.NCF-process file in the submenu that appears.

A text window opens containing the AUTOEXEC.NCF server storage file. At the end of the new line, type LOAD CDROM in this file. Then press Esc and answer yes to save. You can now exit the installation program by pressing the Esc key three times and answering yes to save. The CD-ROM support module will be automatically loaded when the server is restarted.

Command options for the CD-ROM module

After the CD-ROM support module CDROM.NLM has been loaded, you can select three additional command lines on the server console to control the CD-ROM drive. Each of the commands are made by typing CD, followed by additional command letters. Entering CD before every command directs the action toward the CDROM.NLM module.

To get an overview of all possible command lines and their syntax, you can use the HELP command in CDROM.NLM. Type this command on the server console as follows:

```
CD HELP Enter
```

The following illustration shows how it appears on the server console.

```
CD-ROM NLM Command Line Options:
  CD DEVICE LIST
  CD VOLUME LIST
  CD MOUNT [No.] [volume name] ('/mac' or '/nfs', '/G=x' or '/R')
  CD DISMOUNT [No.] [volume name]
  CD CHANGE [No.] [volume name] ('/mac' or '/nfs', '/G=x' or '/R')
  CD DIR [No.] [volume name]
  CD GROUP ([group name] and [group num])
  CD HELP

The [volume name] can be obtained from the first 2 options.
The [No.] can b obtained from the first 2 options.
The '/mac' is used to add Macintosh Name Space Support.
The '/nfs' is used to add NFS Name Space Support.
The '/G=x' is used to set the default volume group access rights..
The 'x' is the number listed from the GROUP Command.
The [group name] is to add a new group name ('del' as name will romove group name).
The [group  num] is used to add a new group name to the group access list (1-9).
The '/R' is used to reuse the created data file on the 'SYS' Volume.
The '/Z' is used to remove any file with a file length of zero.

When mounting or changing a CD-ROM Disk a deactivation of the selected device
will occur.  Do not be alarmed.
```

The CDROM.NLM command lines

The following paragraphs explain the commands which are illustrated above:

1. CD DEVICE LIST

All devices responsive to NetWare 4.0x are assigned an individual number. The number allocation is determined first by the order in which the device controller driver is loaded and then according to the actual number of devices attached to a controller. The numbering of the devices starts with zero. This command searches all CD-ROM drives and then lists all the allocated device numbers or actual devices.

2. CD VOLUME LIST

When a CD is inserted CD-ROM drive and the CDROM.NLM module has been downloaded, the module automatically lists the names of the inserted volumes. When this command is executed, you'll be given the name of all the CDs that have been inserted into responding CD-ROM drives.

3. CD MOUNT

In the same manner that a NetWare volume must be activated on the server's hard drive, CDs must also be mounted and activated to permit common access. If a CD is mounted, the CDROM.NLM module creates an index file in the system volume SYS to accelerate access.

4. CD DISMOUNT

You should use this command to deactivate a mounted CD before removing it from the drive. This will help maintain system consistency and protect data.

5. CD CHANGE

You should use the CD DISMOUNT command before removing a CD and CD MOUNT after inserting a new medium. This command simplifies the process when changing a CD and staggers the deactivation and activation separately with the press of a button.

6. CD DIR

This command can be helpful if you are searching for a particular CD. You can display the directory structure without having to mount an inserted CD. This command may save you some time because mounting a CD can become a long process. This command is helpful with CDs that are not labeled or those you believe may be mislabeled.

7. CD GROUP

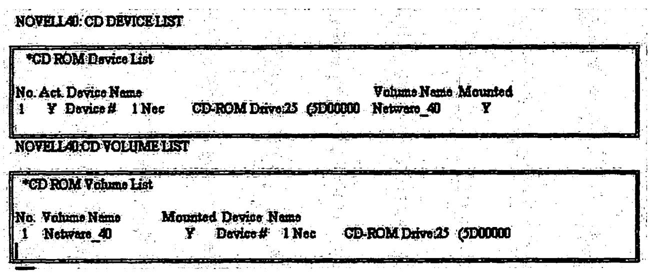
CD access can be regulated with NetWare. This helps provide data protection. It's possible to grant exclusive CD access to a particular user group. An existing group is issued a number with this command. This command can be optionally used when activating a CD, thereby limiting access rights to the selected user group.

8. CD HELP

Displays command lines with the appropriate syntax as we mentioned above.

Reports from CD-ROM drives and CD-volumes

The CDROM.NLM module that controls the CD-ROM drives in a NetWare server has two functions (CD DEVICE LIST and CD VOLUME LIST) that you can use to retrieve information using drives and CD volumes. The following illustration shows an example on how to use these two commands.



Information using drives and inserted CDs

When you type the following:

```
CD DEVICE LIST [Enter]
```

a list of the attached CD-ROM drives will appear on the server console. You'll see up to ten devices listed. If more than ten devices are present, you must execute this command several times to display the next ten CD-ROM drives. For each entry on the list, you'll find the following additional information:

1. No.

This slot gives the CD-ROM drive device number and it is clearly assigned. Device numbering begins with 0 and is first determined by the order in which the controller driver is loaded and then by the number of devices connected to the controller.

2. Act.

Indicates if the CD-ROM drive is operational. This usually concerns external drives because they can be switched on or off. A 'Y' in this field means operational and an 'N' indicates that a device is not powered up.

3. Device (Name)

The displays the name of the connected CD-ROM which is already stored in the drive and ready to be selected. The name is also read and displayed by external devices that have already been switched off.

4. Volume Name

If a CD has been inserted in the CD-ROM, the name of the volume (medium) is displayed. The CDROM.NLM module records the removal and insertion of CDs and displays the status. There is no entry for the name if a CD hasn't been inserted into the drive.

5. Mounted

This field indicates if an inserted volume has been mounted or activated with the letters Y or N.

As all CD-ROM drives can output with the CD DEVICE LIST console command, this is also possible for all available inserted CDs. On the server console, type:

```
CD VOLUME LIST [Enter]
```

As in the last picture, the information provided by this command overlaps, in part, with that from the CD DEVICE LIST command. Nevertheless, this console command provides you with a faster overview of the available CDs.

A maximum of ten CDs are displayed with this command. If more volumes are available, the CD VOLUME LIST command must be repeated to list additional CDs. The following paragraphs list the individual entries and their function:

1. No.

Lists the CD-ROM drive device number for the indicated CD.

2. Volume (Name)

This is the name for the inserted CD. In the example from the last illustration, a CD with the label NETWARE_40 is inserted in the CD-ROM drive which was assigned device number 1

3. Mounted

Indicates if the inserted CD has been mounted or activated. The letters Y or N are used for this purpose.

4. Device (Name)

Indicates the name of the CD-ROM drive. The name is embedded in the device and is retrieved from there.

Access to the CD main menu

You should display the volume's root directory when searching for a particular CD. The CDROM.NLM module provides the CD DIR console command for this purpose. It displays the main menu for the CD which you inserted into the attached CD-ROM drive. This command can be used for activated, i.e., mounted, as well as for deactivated CDs.

Since the time required to mount the CD depends on the capacity of the CD, increased capacity will require more time for activation. This makes it more advantageous to use the CD DIR command even with deactivated CDs. The CD DIR command access abilities are limited to the main menu. The entire file and directory structure of a CD can only be examined in a DOS workstation when a CD has been activated on the server.

```
NOVELL40: CD DIR 1
Display Root Directory On Volume 1

.            <DIR>      7-13-93     4:48p
..           <DIR>      7-13-93     4:48p
CLIENT       <DIR>      7-06-93    10:34p
DOC          <DIR>      7-06-93     6:00p
NETWARE.40   <DIR>      7-06-93    10:34p
NOVINI       <DIR>      7-06-93     5:52p
PUBLIC       <DIR>      7-06-93     5:52p
REV.B        2175703    7-13-93     4:46p

Display Root Directory On Volume NETWARE_40

.            <DIR>      7-13-93     4:48p
..           <DIR>      7-13-93     4:48p
CLIENT       <DIR>      7-06-93    10:34p
DOC          <DIR>      7-06-93     6:00p
NETWARE.40   <DIR>      7-06-93    10:34p
NOVINI       <DIR>      7-06-93     5:52p
PUBLIC       <DIR>      7-06-93     5:52p
REV.B        2175703    7-13-93     4:46p

NOVELL40:
_
```

Reading the CDs main menu volume's main menu

The syntax of the CD DIR command:

```
CD DIR [device number]
```

or

```
CD DIR [volume name]
```

As shown in the illustration above, the CD DIR command can be used in two ways. You can choose whether to state the device number or the name of an inserted CD. The names of a CD can be listed as we explained above by using the CD VOLUME LIST or CD DEVICE LIST commands.

In the illustration, the CD DIR command was used twice on the same CD. It was used first with device number 2, which designates the CD-ROM drive. It was used a second time directly with the name of the CD, listed here as NETWARE_40.

CD mounting

The core function for the CD-ROM support module CDROM.NLM is the activation, or mounting, of CDs. In this way, the resource CD-ROM is available to the network. In mounting a CD, the server is given a newer NetWare volume bearing the name of the CD. Network workstation users can directly access this volume in exactly the same way as on the server hard drive. To mount a CD, use the CD MOUNT command on the console.

The CD-MOUNT command syntax with parameters:

```
CD MOUNT [device number] [volume name] [/mac] [/nfs] [/G=x] [/R]
```

1. [Device number] and [volume name]

You can choose to list either the CD-ROM drive device number or the name of the inserted CD. Both entries are listed with the CD DEVICE LIST and CD VOLUME LIST server commands.

2. [/mac] and [/nfs]

NetWare 4.0x can support not only the DOS file name conventions but also the name conventions of other operating systems. The file and menu information change from the DOS standard. This is especially true when considering the Apple Macintosh and UNIX systems where the Macintosh can create, for example, alias files and folders and the UNIX system can create links. A file or a menu in these two systems can exist many different times in the directory tree, although it's physically there one time.

If you wish to support the name conventions of the Macintosh system, specify the /mac window. To support the name conventions of the UNIX system, specify the window /nfs (Network File System).

3. [/G=x]

A group number between 0 and 9 is designated using the x space holder. This group number can be freely allocated to each of the server's user groups. If you define these optional parameters, CD access is limited to the users of the designated group. You'll find more information on using these parameters in the section on protecting group assigned CD data in this chapter.

4. [/R]

If a CD is mounted in the NetWare server as volume (medium), the module CDROM.NLM creates an index file in the system volume, SYS, to accelerate CD access. If this file has been created, the same CD can be used again in a repeated activity. If this is desired, you could optionally list this parameter.

```
NOVELL40:cd mount 1
Mount Volume on device: 1


ISO-9660 CD-ROM Disc
Mounting Volume Netware_40
** Reading In FAT
** Verifying Directory FAT Chain
** Scanning the Directory
** Checking Subdirectories
** Scanning Files with Trustee Nodes
** Scanning Deleted Files
** Linking the Name Spaces
Volume Netware_40 is read only
Novell40:
```

Mounting a CD

On the screen you'll see the mounting of a CD labeled NETWARE_40, which is inserted into a CD-ROM drive with device number 1. Note that instead of the number 1, the name NETWARE_40 could also be listed.

Immediately after imputing the command, the server begins to mount, i.e. to activate, the CD as a NetWare volume. The module CDROM.NLM, which assumes this task, independently recognizes which CD format from the list of supported formats for ISO 9660 and High Sierra is being used.

After terminating the activation, which comes before the usual procedure for hard drives for NetWare volumes, it is determined that this is an exclusively readable volume. If the volume is unknown to the system, an error message will result due to the fact that the log file VOL$LOG.ERR, which all system volumes set-up and project, cannot be created. Don't panic if you see these messages; they're not important right now.

When the CD is activated, it can be accessed immediately by the network workstations. The section on DOS station access on a CD volume lays out the steps required by a station.

Unmounting a CD

In the last section, a CD was either activated or mounted as a NetWare volume. In this manner, the CD is recognized by the NetWare server and the network user is given access to data. If an activated CD is no longer needed by the network and has been removed from the CD-ROM drive, the activation should

be terminated with the command CD DISMOUNT. Since a CD is a read-only storage medium and no data changes or deletions are possible, there is no associated risk when removing an activated CD from the drive. Although to protect the system consistency, we recommend you use the CD DISMOUNT command prior to removing the CD.

```
NOVELL40:CD DISMOUNT 1
CD-ROM Volume from device: 1 is being dismounted.
Dismounting volume NETWARE_40

8-23-94 10:38:45 am:  SERVER-4.0-684
    Device # 2 CD-ROM Dummy 01 (29000000) deactivated due to driver unload

8-23-94 10:38:48 am:  SERVER-4.0-1355
    Device # 1 NEC   CD-ROM DRIVE:25  (5D000000) deactivated due to media
    dismount

NOVELL40:
```

Deactivating a CD

The CD DISMOUNT command syntax:

CD DISMOUNT [device number] [volume name]

You can list the device number of the CD-ROM drive where the activated CD was inserted and the name of the CD. The illustration above shows the server's reaction to this command. In a deactivation, access is denied to all the CD users since only existing NetWare volumes can be accessed. In activation, a newer volume is added to the system, which is then removed when deactivated and subsequently forgotten. NetWare volumes that have been added to a hard drive are more reliable, since these are usually available on a permanent basis.

Changing a CD

Besides the CD MOUNT and CD DISMOUNT console commands, you can use the CDROM.NLM module command CD CHANGE. This module command combines the first two instructions and simplifies CD changes.

The parameters of the CD CHANGE command are identical to those for the CD MOUNT command, however the parameters for the volume name are different in meaning or in function.

The CD CHANGE command syntax with parameters:

CD CHANGE [device number] [volume name] [/mac] [/nfs] [/G=x] [/R]

1. [device number] and [volume name]

You can choose to list either the CD-ROM drive device number or the name of the CD inserted in the drive. If you list the name, it refers to the CD that will be changed and not to the CD to be inserted.

2. [/mac] and [/nfs]

If the /mac parameter is given, it refers to Macintosh file conventions support. Likewise, the parameter /nfs supports the file conventions of the UNIX world. The /mac and /nfs parameters apply to the CD that will be inserted.

3. [/G=x]

With this optional parameter, access to a CD can be controlled and a designated access group established. We'll discuss this in more detail in the next section.

4. [/R]

If the CD to be inserted had previously been activated, the index file on the system volume SYS can be reused. If this is intended, you must list this parameter.

Deactivation when changing a CD

```
NOVELL40:CD CHANGE 1
CD-ROM Volume (name or device): 1
CD-ROM Volume from device : 1 is being dismounted.
Dismounting volume NETWARE_40

8-23-94 11:28:45 am:  SERVER-4.0-684
    Device # 2 CD-ROM Dummy 01 (29000000) deactivated due to driver unload

ATTENTION OPERATOR: Exchange Media from Divice 1 (wait for spinup).
<Press any key to continue>
```

On the screen, the CD change is initiated for a CD-ROM drive with the number 2 device number with the command:

```
CD CHANGE 2.
```

A CD labeled NETWARE_40 previously been inserted into the drive and activated. It was immediately deactivated to proceed with the CD change. After closing the deactivation, notification is given that the volume can be changed. At the same time you are directed to wait until it has reached its full revolution speed.

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Note the newly inserted CD must reach its full revolution speed before pressing a key. You will notice in the CD-ROM drive light, if the acceleration has been completed and if the activation can proceed. You may then press any key.

```
CDROM>>>-Media Access NOT Availabel on device No. 1

8-23-94 11:35:41 am:  Server-4.0-1353
    Device # 1 NEC    CD-ROM Drive:25 (5d000000) deacivated by driver
    due to device failure

8-23-94 11:35:48 am:  SERVER-4.0-1355
    Device # 1 NEC    CD-ROM DRIVE:25  (5D000000) deactivated due to media
    dismount

Mount Volume on device: 1

ISO-9660 CD -ROM Disc
Mounting Volume CDROM
** Reading In FAT
** Verifying Directory FAT Chain
** Scanning the Directory
** Checking Subdirectories
** Scanning Files with Trustee Nodes
** Scanning Deleted Files
** Linking the Name Spaces
Volume CDROM is read only
Novell40:
```

Activation after CD change

The illustration shows the CDROM.NLM module's reaction after pressing the key. It is attempting to activate the inserted CD. The operation corresponds to the completion of the CD MOUNT command. In the illustrated examples, the NETWARE_40 CD is exchanged with the CDROM CD.

Protecting group assigned CD data

Since each NetWare server user can access an activated CD, it may be necessary to restrict unauthorized access to sensitive, private or classified data. The CDROM.NLM module opens the parameter /G=x for the CD MOUNT command for this purpose. The wild card x represents a number from 0 to 9 that has been assigned to a server group.

The console command CD GROUP arranges the group. The following two lines show two possible syntaxes of this command:

```
CD GROUP [group name] [group number]
```

or

```
CD GROUP
```

The name of the server group is established with the parameter group name. The group number can then be freely selected. The CD GROUP command must be stated with either both or neither parameter. The call shows the actual group assignments and numbers without additional details. Assignments are either given or changed under different circumstances. The following illustration shows a few assignment examples:

```
NOVELL40:CD GROUP

*CD ROM Access Group
*Group: 0 > EVERYONE

NOVELL40:CD GROUP ACCOUNTING 5

*CD ROM Access Group
*Group: 0 > EVERYONE
*Group: 5 > ACCOUNTING

NOVELL40:CD GROUP CONTROLLING 8

*CD ROM Access Group
*Group: 0 > EVERYONE
*Group: 5 > ACCOUNTING
*Group: 8 > CONTROLLING

NOVELL40:CD GROUP GRAPHICS 12

  CDROM-4.10-059:>> ERROR:
    Invalid Group Number (1 - 9)
NOVELL40:
```

Establishing group numbers

The first command shown on the screen without additional parameters is CD GROUP. The preadjustment is arranged so group EVERYONE receives group number 0. Next, the accounting and controlling groups are added to the actual CD-ROM group configuration with the numbers 5 and 8.

After each group assignment change, the CDROM.NLM module indicates the actual configuration. The number 12 is assigned to the group management with the final console command. This is discharged from the system with an error message. Be careful that these assignments are not stored long term and that the preadjustment remains intact after starting the server again: group EVERYONE assigned group number 0. To automatically set the group arrangements after restarting the system, you can call up the CD GROUP command with its respective parameters in the AUTOEXEC.NCF start file.

You can change the AUTOEXEC.NCF file and add or remove lines, as described in this chapter in the section on the installation of the CD-ROM support module. It is most important that, prior to stating the CD GROUP command, the CDROM.NLM module is downloaded. The corresponding line reads: LOAD CDROM.

Now that you know how groups are created, the following example should show how group assignment is used. We're assuming, for example, that a CD with the label FIBU92 which contains confidential data is to be activated on the NetWare server for opening up the accounting group. This is typed on the console as:

```
CD GROUP ACCOUNTING 5
CD MOUNT FIBU92 /G=5
```

The parameter /G=5 establishes that the previously assigned accounting group holds exclusive access and is the connection between the CD GROUP command and the CD MOUNT command. To remove already assigned groups from the list, the CD GROUP command is used, but instead of entering the name of the authorized group, enter the password DEL. The following illustration shows how to delete groups using the CD GROUP command.

```
NOVELL40:CD GROUP

*CD ROM Access Group List
*Group: 0 > EVERYONE List
 Group: 5 > ACCOUNTING
 Group: 8 > CONTROLLING

NOVELL40:CD GROUP DEL 5

*CD ROM Access Group List
*Group: 0 > EVERYONE
 Group: 8 > CONTOLLING

NOVELL40:CD GROUP DEL 0

*CD ROM Access Group List
 *Group: 8 > CONTOLLING

NOVELL40:
```

The newly created groups, ACCOUNTING and CONTROLLING, and the prearranged group, EVERYONE, are distributed next. Lastly, by typing:

```
CD GROUP DEL 5
```

and

```
CD GROUP DEL 0
```

the ACCOUNTING and EVERYONE groups will be deleted. Now, all that remains is the CONTROLLING group with the group number 8. Existing group assignments can also be overwritten if a new group is assigned to a group number. Prior deletion is not necessary.

DOS station access on a CD volume

In the previous sections, the set-up and management of the CD-ROM services on a NetWare server were examined. Finally, the value of these services at a DOS workstation are examined.

First, the workstation must be registered in the network, so first access is given to the resources. All that is required for this purpose is the LOGIN command and entry of a user name or even a password. Since data access on a DOS station is achieved using drive letters, you must assign a drive letter in the form of a NetWare volume to the activated, or mounted, CD. The NetWare MAP.EXE program is helpful. The following illustration shows the application for this program.

```
F:\>MAP X:=NETWARE_40

Drive X:= NOVELL40\NETWARE_40: \

F:\>X:

X:\>DIR

 Volume in drive E is NETWARE_40
 Directory of E:\

CLIENT          <DIR>     07-06-93 10:34p
DOC             <DIR>     07-06-93  6:00p
NETWARE 40      <DIR>     07-06-93 10:34p
NOVINI          <DIR>     07-06-93  5:52p
PUBLIC          <DIR>     07-06-93  5:52p
REV   B         2,175,703 07-13-93  4:46p
      6 file(s)  2,175,703 bytes
                 0 bytes free

X:\>
```

Access to a CD in the network

In the example above, the drive letter x represents a logical drive which has been inserted to access the CD labeled WINDOWS_NT. The assignment is entered in the DOS station as:

```
MAP X:=NETWARE_40:
```

Of course, you can select a letter other than x. The MAP service program expands the path around the file server's name, as illustrated, or, as in this example, NOVELL40. The NetWare volume name NETWARE_40 is the name of the activated CD.

The x drive is available immediately after executing MAP.EXE. Access follows the same procedure as in other network drives, however all files and directories are exclusively readable. Changes are not possible since we are dealing with a CD. All attempts in this direction will elicit an error message. The illustration also shows how the DIR command effects the x drive and the root directory of the CD NETWARE_40. Now all workstations can access the CD volume if they are connected to the NetWare server.

Using A CD ROM Under OS/2 2.1

IBM's OS/2 is becoming a true multimedia system. As you would expect from a modern 32-bit operating system environment, support for CD-ROM drives is fully integrated. Using a CD-ROM drive is essential for a multimedia system, especially when you consider the large amounts of data that are involved.

CD-ROMs With Novell & OS/2

CD-ROM support from OS/2 2.1

You shouldn't have any problems using CD-ROM drives with OS/2 2.1. The OS/2 2.1 installation diskettes contain an extensive collection of drivers.

The OS/2 2.1 32-bit operating system supports Adaptec, Future Domain and DPT SCSI controllers and 37 different SCSI CD-ROM drives including IBM, Hitachi, NEC, Panasonic, Pioneer, Sony, Texel and Toshiba. You can obtain additional drivers from third party manufacturers, download them from CompuServe or from one of the many OS/2 bulletin boards.

For example, if you own the CD-ROM version of OS/2 and want to install the system from your CD-ROM drive, the boot diskettes included with the CD-ROM version of OS/2 must contain the drivers for the controller and CD-ROM drive.

OS/2 2.1 is able to recognize and install these components on its own. Refer to the table below to see which controllers and drives are supported by OS/2. However, remember the drivers for your components may not be compatible. The user manual for OS/2 2.1 contains a comprehensive table of possible combinations.

If you don't have the type of hardware supported by OS/2 2.1, you'll need to use one of the basic drivers made by the manufacturer of the components. You will recognize these device drivers by the .ADD extension (Adapter Device Driver).

The following list shows you which drivers are included with OS/2 2.1 and which SCSI controllers are supported by OS/2 2.1:

- Adaptec 1510, 1520, 1522, 1540, 1542, 1640, 1740, 1742, 1744
- DPT PM2011, PM2012
- SCSI Adapters for IBM PS/2
- IBM 16-Bit AT Fast SCSI
- Future Domain 845, 850, 850IBM, 860, 875, 885, 1650, 1660, 1670, 1680, MCS700, 7000EX

The next list shows the SCSI CD-ROM drives supported by default:

- CD Technology T3301
- Hitachi CDR-1650, 1750, 3650, 3750
- IBM CD-ROM I

- IBM CD-ROM II
- NEC 25, 36, 37, 72, 73, 74, 82, 83, 84
- NEC Multispin 38,74, 84
- Panasonic CR-501, LK-MC501S
- Pioneer DRM-600, DRM-604X
- Sony CDU-541, 561, 6111, 6211, 7211
- Texel DM-3021, 3024, 5021, 5024
- Toshiba 3201, 3301, 3401

OS/2 2.1 also supports IDE and AT-Bus CD-ROM drives but does not include the drivers for these. You'll have to purchase the necessary drivers for these CD-ROM drive types separately, e.g., from your dealer.

Adding and modifying device drivers after installation

OS/2 2.1 usually will recognize the controller and the connected CD-ROM drive. However, under the right circumstances you may still need to make changes to the configurations made by OS/2 during installation.

Therefore, we'll explain the procedure in this section for adding the necessary device drivers after installation. For example, in OS/2, device drivers are control programs responsible for operating SCSI controllers and SCSI CD-ROM drives.

In the following descriptions, we'll assume that you have already installed the CD-ROM and connected it to your computer. We'll also assume that you have experience working with the OS/2 2.1 Workplace Shell. Otherwise, you can quickly familiarize yourself with OS/2 2.1 by running the OS/2 tutorial and reading the OS/2 user manual.

1. First, boot OS/2 2.1 and open the OS/2 System object on the Workplace Shell. To do this, double-click the OS/2 SYSTEM icon with your mouse. You will recognize the OS/2 SYSTEM icon by its OS/2 symbol.
2. After that, a selection of objects appears. Double-click the System Setup object.
3. The System Setup - Icon View window appears. Double-click the Selective Install icon.

4. The System Configuration window opens. You can set options for the mouse, the primary display, country and add peripherals to the system. The installed peripherals appear in the lower-right section of the window. The system automatically recognizes the CD ROM and the SCSI controller (provided these items are supported by default).

5. To change or add options, use the mouse or press the Spacebar to place a checkmark to the left of the feature and then click the OK button. For example, to change the CD-ROM Device Support, simply click the mouse on the box to the left of the option. The checkmark which then appears indicates this position is being considered for a change.

6. Now click the OK button and a window appears, from which you can select one or more CD-ROM devices. Use the scroll bar to move within the list. Click the mouse button to highlight the desired device. To select more than one device, hold down the Shift key as you click the CD-ROM devices.

7. Now click the OK button to confirm your selections.

Follow the instructions on the screen for exiting the installation program.

Installing OEM device drivers

If the driver for your CD-ROM isn't one of the default drivers, you'll have to use the driver included with the CD-ROM drive. If your CD-ROM drive didn't include any drivers, you can usually get the appropriate device drivers from your computer dealer or the manufacturer of the drive.

We'll explain how to install these OEM device drivers and make them available to your system in the following paragraphs. Again, we'll assume that you have already completed hardware installation of your CD-ROM and connected the CD-ROM to the controller, so only the software settings must be made. We'll also assume that you are familiar with the OS/2 operating system and know how to use the Workspace Shell. Otherwise, please see the OS/2 2.1 user manual for detailed descriptions on using the elements of the Workspace Shell.

1. Start your computer and, if you have other operating systems installed besides OS/2 2.1, initiate the boot process for OS/2. The Workplace Shell appears.

2. Open the OS/2 System object, which contains folders for adapting the system to your requirements and other important functions. To do this, double-click the OS/2 System icon.

3. Various objects are displayed on the screen. Double-click System Setup. The System Setup object contains other objects for customizing your system.

4. Next, choose the Device Driver Install object by double-clicking it.

5. The OS/2 2.1 Device Driver Installation window opens. Select the source and destination directories in this window. To change the default drives, click the [Change] button and choose the appropriate drive.

However, if the drive letters and/or directory specifications correspond to your requirements, you are ready to begin installing the device drivers: Choose the [Install...] button.

6. From the list that appears, select the appropriate device driver that will let you run the CD ROM drive under OS/2 2.1. Then confirm your selection by clicking [OK].

Remember, you cannot install printers, plotters or drivers from the OS/2 Installation diskettes with the Device Driver Install object.

Accessing the CD ROM drive from the OS/2 Workplace Shell

CD-ROM drives are usually handled like hard drives, except for the limitation of read-only access and performance that is usually significantly lower. OS/2 2.1 is no different in this respect.

After installing your CD-ROM drive, you can access it through the Drives folder. You'll find this folder in the OS/2 System window. The Drives folder gives you general access to all drives or storage media available to the system.

Double-click the OS/2 System icon to open the object. Then choose the Drives folder from the OS/2 System - Icon View window. The Drives - Icon View window displays all the drives you have installed on your system. For example, you can access disk drives, hard drives, CD-ROM drives, tape drives and optical drives.

To view the data on the storage medium, which in our case is the data from the CD in the CD-ROM drive, simply double-click the appropriate drive object. The drive window opens, displaying the contents of the storage medium in standard format. For example, if the medium contains directories, they are displayed on the screen as a tree structure.

There are three kinds of display: Icon View, Tree View and Details View. You have the option of changing the default view and setting it before you open an object. For example, to open the drive object for the CD-ROM drive, move the mouse pointer to the CD-ROM icon and click the right mouse button. A popup menu opens. Next, choose the arrow to the right of the Open option by double-clicking it.

Another menu appears with the following options:

Settings

Choose **Settings** to change the configuration of the view and view information about the storage medium.

Icon View

Choose **Icon View** to display the contents of the medium using different icons, such as folders or forms.

Tree View

Choose **Tree View** when there are directories on the medium. A plus sign next to a folder (directory) indicates that the folder contains additional folders. Click on the plus sign to expand the folder, i.e., to display its folders.

Details View

Details View lets you display the contents of the storage medium with a series of additional information. Along with the different icons, you get information on the title, real name, size, last write date and time, last access date and time, creation date and time and flags (attributes) in the Details View window.

To view the contents of the storage medium in a different display or sort order, click on the title-bar icon. Choose the arrow to the right of the Sort option in the pop-up menu which appears next. Another menu appears with various sorting criteria such as type, size, creation date etc. This makes your search for specific files easier.

An alternative is to use the Find option. Click on the Find menu item and type the object for which you are searching in the Name field. You can also use the wildcard characters * and ? to replace a series of characters or a single character.

Ejecting CDs from the CD ROM drive

You have several methods of removing a CD from your CD-ROM drive. You can simply push the Eject button on the CD-ROM case (although this method won't work with some drives when they are switched on).

You can also open the System object and choose the Drives object. To do this, double-click the OS/2 System icon on the Workplace Shell. Next, double-click the Drives object in the OS/2 System window to display an overview of the disks available to the system. To remove the CD from the CD-ROM drive, click the right mouse button on the CD-ROM icon. The popup menu that appears contains an item called Eject disk, which you can choose by clicking the mouse. The program then ejects the CD from the selected drive.

You can also eject CDs if you are in one of the View windows of the drive that show the contents of the CD (see Accessing CD-ROMs from the OS/2 Workplace Shell). Click the title bar icon of the window and then choose Eject disk.

OS/2 2.1 multimedia features

The extensive multimedia features of OS/2 2.1 are located on either two diskettes or on the CD if you installed the CD-ROM version of OS/2 2.1.

After installing the Multimedia Presentation Manager/2 (MMPM/2), you have additional options for using your CD-ROM. Among these options are playing back audio CDs or integrating sound and image etc.

Refer to Chapter 6 in the OS/2 2.1 Installation Guide when you want to learn how to install multimedia features on your OS/2 system. You'll find some tips on the performance features of the Multimedia Presentation Manager/2 and detailed instructions on installation.

The CD-ROM version of OS/2 2.1 also contains some additional files (samples) for multimedia features which are not available on the diskette version. For example, there are film and sound files that you can play with the programs included in the multimedia support for OS/2 2.1.

After you install the program package, different objects that perform some extremely interesting applications will be available to you. You can play back, record and edit sound data. You will also be able to play back digital video files in AVI format with the digital video media player feature, without special hardware. The OS/2 2.1 CD contains a few video files of this format.

However, another feature called Software Motion Video lets you play high resolution digital film files in a window on the Workplace Shell of OS/2 2.1.

For example, you can view film files in RTV (Real Time Video) mode or PLV (Production Level Video) mode. These files are part of DVI technology (Digital Video Interactive), a special compression/decompression technique for image data developed by IBM and Intel. However, to use this technology you need a special adapter that manages compression and decompression at hardware level. CD-ROM drives with a transfer rate of 150K can have difficulties, resulting in sluggish playback of film data. You'll achieve the best results by using 330K drives because these drives can play film smoothly.

Playing Audio CDs under OS/2 2.1

To play audio CDs, you must install the IBM Multimedia Presentation Manager/2. Even users who don't have a need for multimedia will enjoy the option of playing audio CDs on a CD-ROM drive. We provided a few tips earlier on installing Multimedia Presentation Manager/2 and you may want to review those tips if you have not installed Multimedia Presentation Manager/2 yet.

CD-ROMs With Novell & OS/2

First, we'll give you a few hints on connecting speakers to the CD-ROM drive and playing audio CDs from the integrated audio system of the computer. This arrangement is possible with Ultimedia computers from IBM where sounds are played directly from the IBM CD-ROM (drive) through the integrated audio subsystem in stereo quality. However, other methods of improving the sound quality are available if you don't have this type of system.

The easy method involves connecting active speakers or headphones directly to the headphone jack of the CD-ROM. You can improve on this method with the help of a few simple resources to harness the high quality properties of a sound card installed in the computer.

All you need is a cable that runs between the CD-ROM drive and the audio card. Usually you can use a cable with 3 pin phono plugs on both ends. You plug one end into the headphone jack of the CD-ROM drive and the other end into the audio input of the sound card. Then you can settle down and enjoy your music.

Before you can use audio CDs in OS/2 2.1 you'll need the Compact Disc application from the Multimedia folder. Double-click the Multimedia icon on the Workplace Shell to start Compact Disc. The Multimedia folder opens and displays different multimedia applications. Choose Compact Disc to play audio CDs.

After double-clicking Compact Disc to start the program, you are prompted to insert an audio CD in the CD-ROM drive. If you have already done this, you will see the tracks of the CD in the program window in small numbered boxes.

Now you have nearly the same functions available as those offered by a CD player. You'll find controls for Pause, Stop, Play, Scan backward, Scan forward and volume settings at the bottom of the Compact Disc application. Click the button to initiate the appropriate function. For example, click the Play button to play a CD.

Click the title bar icon for other options. A popup menu appears displaying different options for controlling audio CDs. We'll describe of few of these options to conclude this section.

Automatic Play

Click on the title bar icon to call the popup menu. Select the **Options** menu item and then the **Automatic Play** function. Next, click on **Automatic Play** so a checkmark appears to the left. The Compact Disc program automatically plays the audio CD every time you call it..

Repeat

This is another item of the **Options** menu. The program plays the last audio CD from which you played music, starting from the beginning of the CD when you enable **Repeat**.

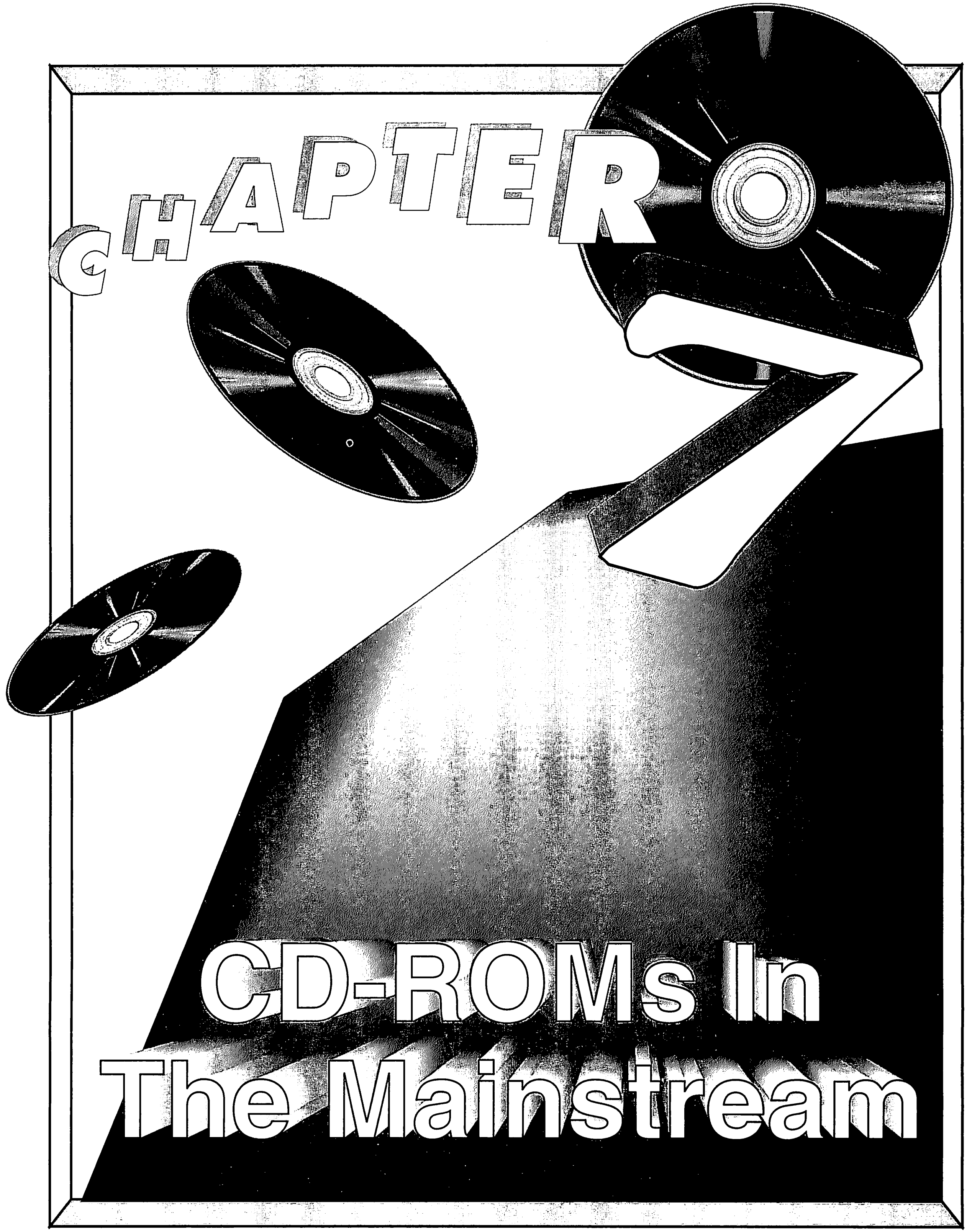
Controls

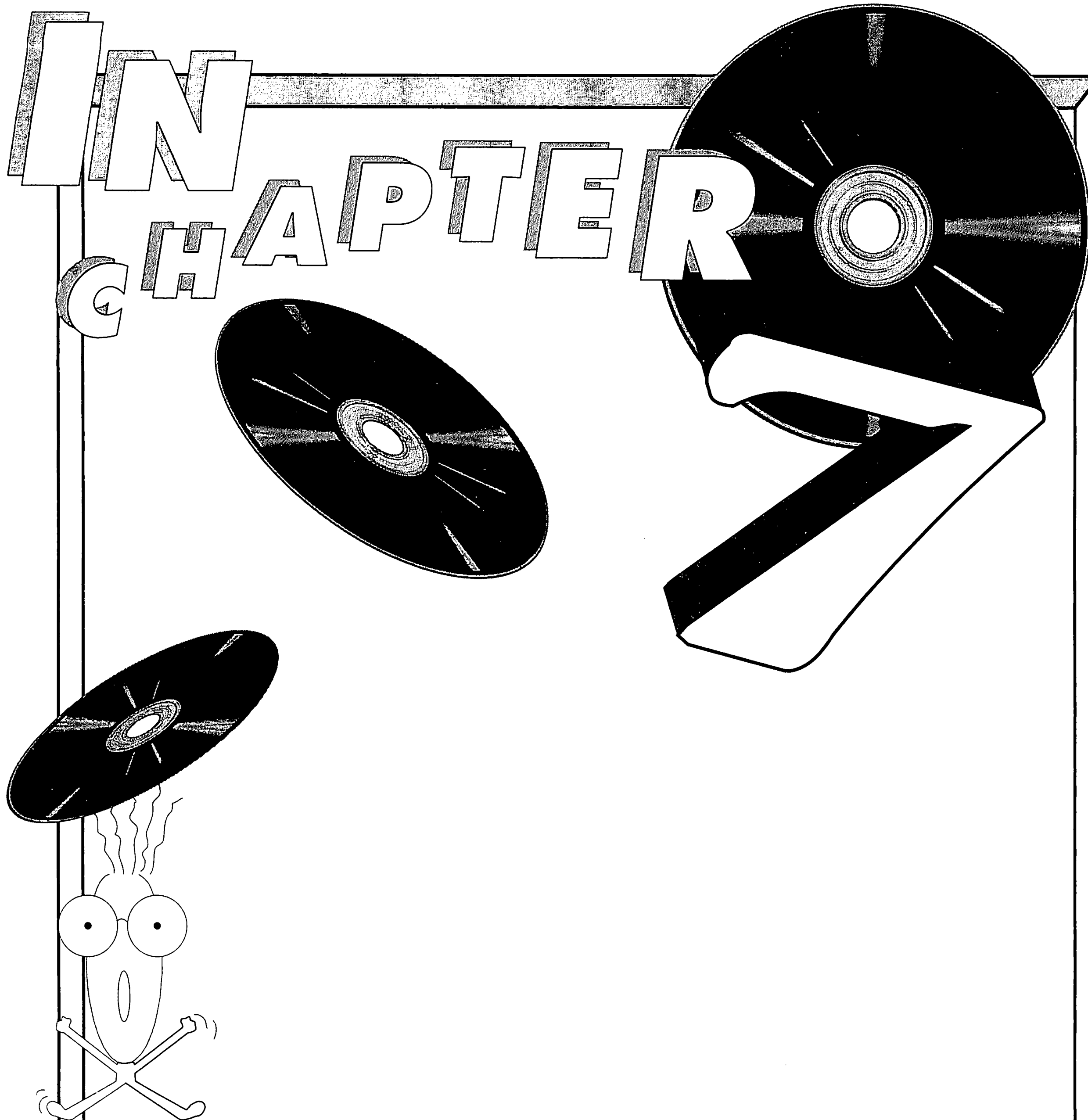
You can also use the controls for the CD-ROM through the menu of the title bar icon. The functions of Compact Disc are available from the **Control** menu. You can even eject CDs in the **Control** menu.

Edit Title...

The **Edit Title** function makes it easier for you to manage CDs by allowing you to assign names to CDs you insert in the CD-ROM drive. The function saves the name and recognizes it, displaying it in the Compact Disc window whenever you insert the CD into the CD-ROM drive.

To edit the title, click the title bar icon and choose **Edit Title...**. A window appears in which you can type a 32 character long title for the current CD. Then click the [Save] button to save the name you gave to the CD, or press the [Cancel] button to discard the title.


CHAPTER 7
CD-ROMs In
The Mainstream


IN CHAPTER 7

7 CD-ROMs In The Mainstream

It wasn't too long ago that the CD-ROM drive was one of the most desirable add-ons. Today, the CD-ROM can no longer be considered just an add-on. Consider some trends.

According to a recent Wall Street Journal report, more than 6 1/2 million CD-ROM drives were sold in 1993. For 1994, this number is expected to reach more than 17 million drives. This means that almost 1 of every 5 PCs in use will be equipped with a CD-ROM drive.

Furthermore, in 1993 just under 60% of all PC's sold included a CD-ROM drive. This is expected to increase to more than 75% of all PC's sold in 1994. So it's already evident that buying a CD-ROM drive is not an afterthought.

If you haven't been following closely, there are two major reasons for this trend.

First is price. The end-user price of the CD-ROM has dropped drastically. Just two years ago, the average price of a single-speed, add-on CD-ROM drive was about $350-$400. Today, you can buy a double-speed CD-ROM drive for less than $200. In fact, in many urban price-competitive areas, the price is probably closer to $150. By the end of the year, many believe that this will drop to less than $100. At this price, adding a CD-ROM drive to a PC isn't a great investment.

Second is software. There are literally thousands of CD-ROM applications now available. But in order to take advantage of these new, innovative, powerful and exciting new software, users have to have a CD-ROM drive.

Computer manufacturers have responded quickly to these trends. Every major manufacturer makes one or more multimedia model computer. With a built-in CD-ROM drive, sound card, set of speakers and included CD-ROM titles, the end user doesn't even have to do any setting up. The computer is ready to run those impressive multimedia applications right out of the carton. This saves him or her hours of additional work and configuration.

CD-ROMs In The Mainstream

What's On The Horizon?

Portability and easy of mobility

Notebook computers are not only fashionable these days. For many business men and women whose jobs keep them on the road, notebooks are indispensable. At one time, notebook computers were merely "cut down" versions of their desktop counterparts. They had less memory, were bundled with "lite" versions of software, operated with slower peripherals and had very limited hard disk space. But more and more, users are demanding and computer makers are providing notebook with the same power, speed and applications as the desktop. And on top of this all, the prices of the notebooks have tumbled to very affordable levels.

Several models of notebook computers have built-in CD-ROM drives and speakers making them portable multimedia computers. These aren't very light; most weigh about ten pounds (4.5 kilos), so you must be quite fit to be able to lug them around for any length of time.

Still other models of notebook computers can be easily adapted to use CD-ROM drives. One way is to use a parallel-to-SCSI adapter. This device plugs into the notebook's parallel port and converts it to a SCSI adapter. A standard SCSI CD-ROM drive can then be used.

A second way is to use a PCMCIA SCSI adapter. Most notebook computer's have a built-in PCMCIA slot, a credit card size opening, into which a variety of adapter cards can be inserted. One type of card is a PCMCIA-SCSI adapter with which you can also use a standard SCSI CD-ROM drive and/or any other type of SCSI device. In fact, there are also PCMCIA-sound cards that adds sound capabilities to a notebook computer in the same way as a full-size sound card in a desktop does.

Speed and capacity

Today's "standard" CD-ROM drive is really a double-speed drive. It's rare that anyone sells a single-speed drive nowadays.

You can also buy triple-speed and quad-speed drives. They're considerably more expensive than the double-speed drives, but some applications demand the additional speed that they can provide. Most triple-speed and quad-speed drives also have much larger cache memories on board. The additional cache memory is especially helpful for applications in which the data is accessed sequentially.

There's been a lot of talk about a new Blue Book definition for the next generation of CD-ROMs.

Why do we need a next generation? The most compelling reason is due to the high storage requirements of video. Consider that traditional films are played at 30 frames per second. To reproduce the same 30 frames per second using a 320 x 200 VGA screen in 256 colors requires more than 7 Meg of storage for each second of video.

Using MPEG compression, this can be reduced to 1/50th of that size. MPEG compression works by removing information that doesn't change from frame to frame. As you can imagine, processing video on a computer involves huge amounts of data. To be able to compress the data, MPEG relies on both hardware and software to do the job.

Yet even with MPEG compression, a CD disc is limited to about 70 minutes of video. Our taste for entertainment, presentations and training demands longer video recordings.

A British company named Nimbus Technology & Engineering has come up with a way to pack more than 1 Gigabyte on a disc, enough for about 135 minutes of video. It, too, uses MPEG compression, but because the recording method conforms to the CD-DA standard, Nimbus claims that the videos can be played on a standard audio player with a special adapter that connects to your television.

According to preliminary information, the Blue Book defines a new high density CD-ROM called an HDCD. By using a narrower laser beam and an improved optical system the capacity of an HDCD can be increased to 3.3 Gigabytes of user data, roughly five times the current capacity. So it appears that the video aficionados will have their way if these developments are realized.

Summing it up

Not very long ago, the 360K floppy drive was used as a mass storage device. True, it had a limited storage capacity, but it served many users well - for a while.

When IBM delivered their first personal computers with hard drives, these users were elated. How could anyone fill a 10 Meg drive? Their joy didn't last long.

In recent years, the capacity of hard drives has rocketed at the same time as their prices have dropped. The upshot is that today's personal computers are routinely equipped with 400 Meg or larger drives.

It seems as if a computer maxim should read something like this: "You can never have too much hard disk space".

If the past is a good predictor of what's to come, then the "standard" capacity of a hard drive will soon catch up with that of the CD-ROM.

CD-ROMs In The Mainstream

So why then, is the CD-ROM important?

In the context of the video entertainment industry, the CD is an alternative to VHS cartridges. You pop a disc into a video CD player and view it through your television. You can also slip the disc into a CD-ROM drive and view it thorough your computer. But it isn't likely that you'd want to copy the contents of a video CD to your hard drive to view it.

However, video CDs don't begin to suggest the importance of CD-ROMs. To continue in the entertainment world, we can point to immensely popular CD-ROM based games such as Myst and King's Quest. These favorites bring to the screen a combination of some wildly imaginative animation, wonderfully vivid graphics, impressive music and sound and a touch of humor. These productions are made possible owing to the storage capacity of the CD-ROM. Without it, installation would require dozens of diskettes, lots of time and a greater expense. And a single game could fill your hard disk in no time at all.

In the educational world, we can point to several impressive CDs. One of the earliest multimedia references was Compton's Multimedia Encyclopedia. Now in its third major revision, it is equivalent to a multivolume encyclopedia in electronic form. It features sound including voices of famous historical personalities, video clips and animation, helpful study aids for recording notes, and other reference materials. There are thousands of other educational products on CD, and each would occupy a complete hard drive of its own. Compared to the bookshelves that a 24-volume set encyclopedia requires, a CD becomes an environmentally correct investment. We can quickly see that CDs are a practical way to dispense these products.

In the training world, we have seen the emergence of interactive CD-ROM based tutorials and learning. Commonly know as CBT, for Computer Based Training, these CDs present lessons using full-motion video and sound. You interact with the computer as the training proceeds, supplying personal information and answers lesson exams. Based on the quality and correctness of your answers, subsequent lessons are tailored to provide additional training for incorrect or weak answers. This type of training may soon supplant or supplement other passive training methods that aren't flexible enough to respond to the student. Many industries are turning to CD-ROM based CBT to at the same time decrease expenses while improving the training effectiveness.

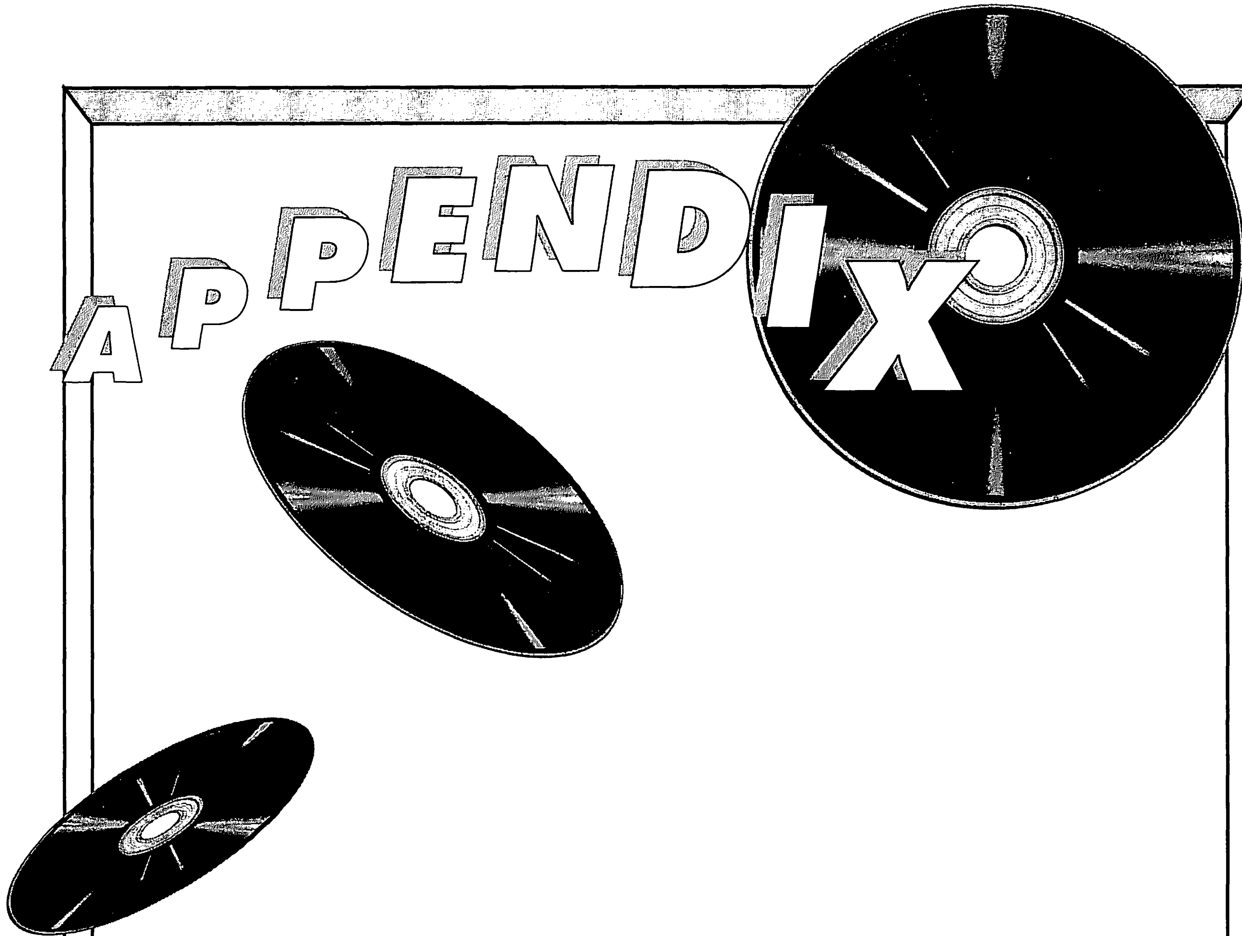
In the business world, many innovative products have been appeared that take advantage of the huge storage capacity of CDs. For example, a direct mail business periodically cleans its customer database to remove names of people who have moved and to change the addresses to conform postal delivery regulations. Now this business can clean its list by checking it against a CD-ROM based database of valid names and addresses. The software automatically corrects addresses or removes names of people who have moved. At the same time, it can prepare the database for a bulk mailing which reduces the cost of a mailing. This huge national database fits on a single CD and is updated frequently from US Postal

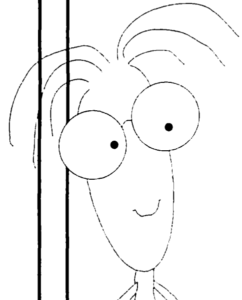
Service records. Other similar uses of tailored-for-business databases include prospecting for new customers from corporate listings; searching for patents, copyrights and trademarks; automated directory assistance from CD phonebooks.

In the computer world, CD-ROM has changed the way that many applications are sold. For example, most desktop publishing software packages are now complete studios. Until recently, installing the application software meant that you had to sit there and swap several (sometimes a dozen or more) diskettes over a 30 minute interval. With CDs, it becomes easier and faster to install the software. In addition to the application software, a typical DTP package has literally thousands of "extras" including: color clip art galore, scanned photo-quality images, dozens of new fonts in different sizes and styles, ready-to-use templates and samples, computer-based tutorials and teaching aids.

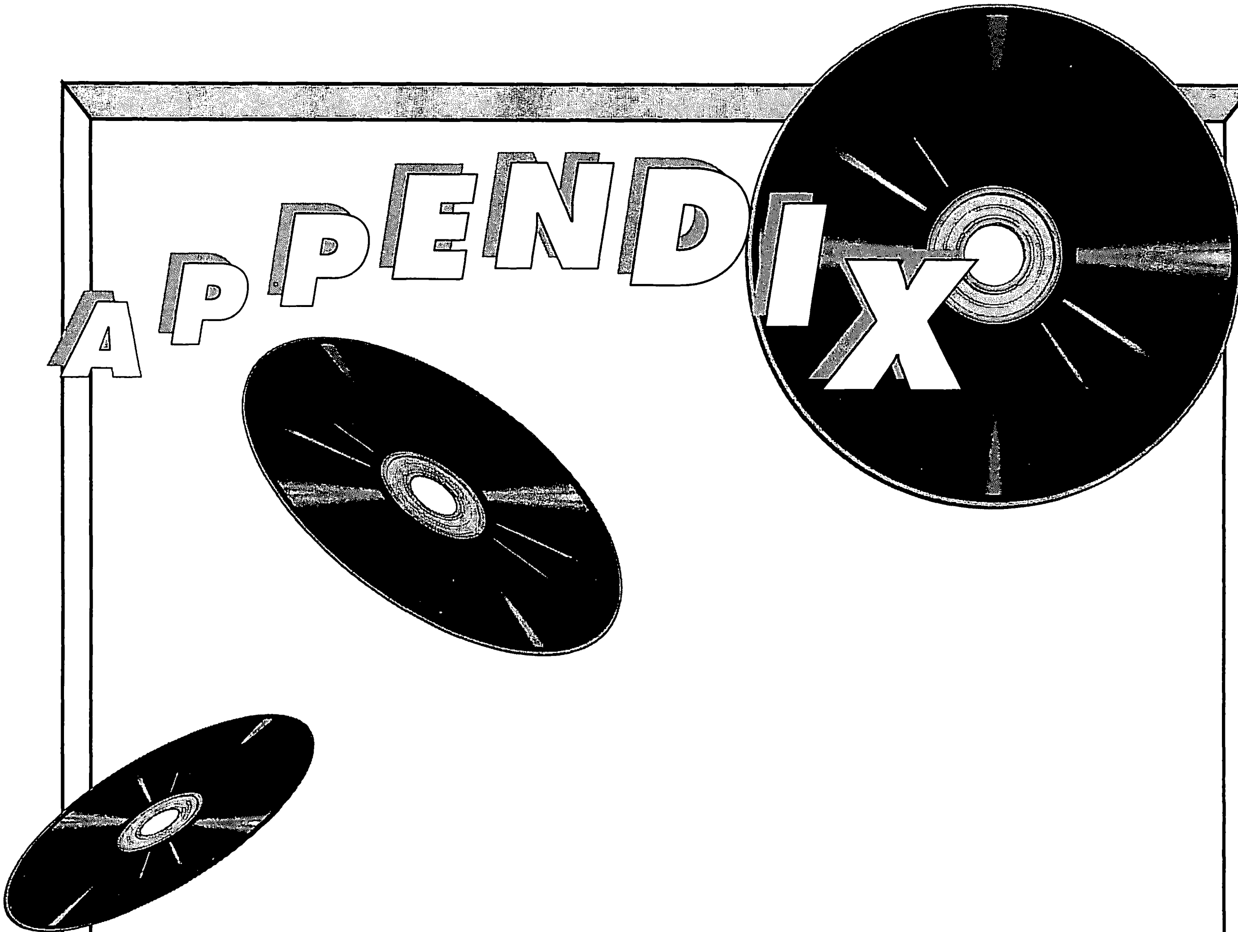
It's true that many of these examples are possible with mediums other than CDs. But CDs make them very affordable and above all very practical. We expect that CDs will be around for many years to come.

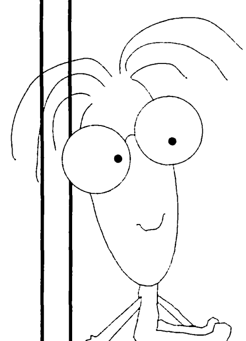
APPENDIX





APPENDIX





Appendix A It's On The Companion CD-ROM

The companion CD-ROM includes hundreds of megabytes of the following programs and applications:

- DOS programs
- Microsoft Windows applications
- Software tools for processing graphics and sounds
- Several DOS and WINDOWS utilities to improve the performance of your PC and your CD-ROM drive.

CDCHECK can help you view your CD setup, so you can achieve maximum performance. The **HyperDisk SpeedKit** includes the tools you need to improve the overall performance of your PC system. Both can help you be more productive.

MENU.EXE

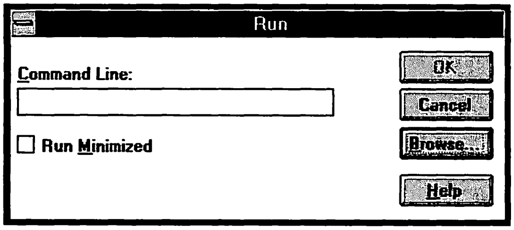
The most convenient method of using the CD is by using the menu. The MENU.EXE program in the root directory of the companion CD-ROM, is a Windows application that lets you access the contents of the companion CD-ROM.

There are two methods to start the MENU program.

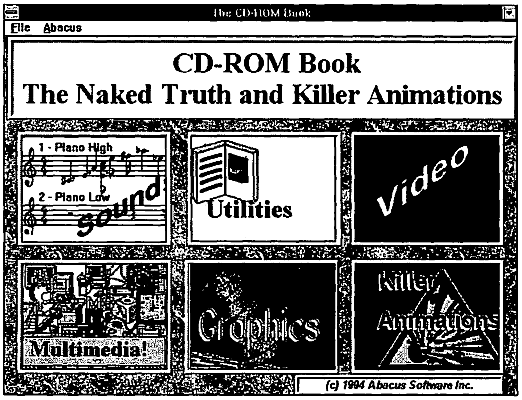
1. To start the program from DOS, type the following (change D to correspond to the drive letter of your CD-ROM drive):

   ```
   D:MENU
   ```

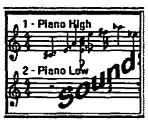
2. To start the program from Windows, select **File/Run...** from the Program Manager. When the "Run" dialog box appears, type the drive letter for your CD-ROM drive and the name MENU.EXE.



Click OK. The following window appears:



The Icons



The six icons let you access or install components found on the companion CD-ROM.

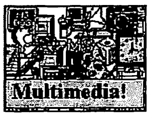
The "Sound" icon lets you install or run the following programs: CDPLAY, GOLDWAVE and MUSIC SCULPTURE.

The "Utilities" icon lets you install CDCHECK and CACHE (HyperWare's SpeedKit).

The "Video" icon lets you install or run the AutoDesk Animation Program and install MORPH.

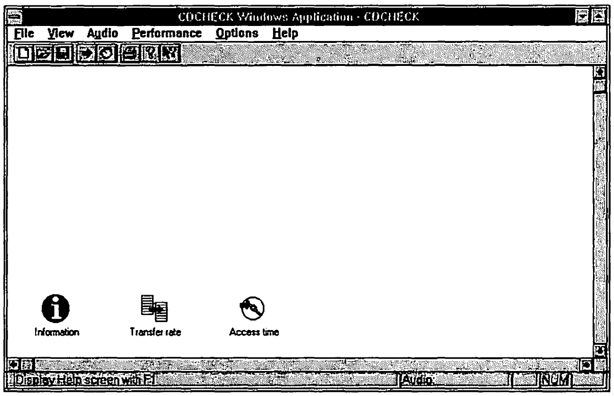
The "Animation" icon lets you install or run the NITRO animation player and editor.

The "Graphics" icon lets you install or run Graphic WorkShop for Windows, PhotoLab, PaintShop Pro and WinView.



The "Multimedia" icon lets you install VIDVUE.

CDCHECK



CDCHECK performs various tests on your CD-ROM drive. Always run the tests with the same settings (in the **Performance/Settings** menu), so you can compare test results.

To test the access times on the CD, CDCHECK positions the read head of the CD-ROM drive to a specific sector, reads one or more areas from the disc, repositions the read head to a different sector; and begins to read again. This activity time is measured using the system timer. You should note that the resolution of the system timer is only 55 milliseconds. This means that measurements are accurate up to about 55 ms. This can lead to inaccuracies at the beginning and ending of the measurement period with a combined error of 110 ms. Since this value is not effected by the length of measurement period, a single observation of 550 ms may have a 20% fluctuation due to the timing inaccuracy. For shorter times, the measured value may fluctuate even more. Therefore the test results are greatly dependent upon how much data on the disc is being tested.

Regardless of this timing limitation, we depend on the law of averages to even things out. To decrease these fluctuations, run several tests and divide the results by the number of tests performed. This enables you to eliminate high deviations to get realistic values.

Since a CD-ROM drive has relatively long access times (300 - 900 ms), you will probably want to repeat the tests several times to measure the performance. However, there will be more fluctuation with this method than if you run longer tests with more repetitions.

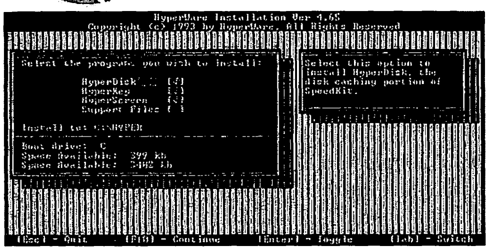
Access times printed in magazines either contain the same fluctuations or are the result of an appropriate averaging process.

The fluctuations are most noticeable in the "Min/Max test". The duration for a single measurement is the longest for this test, which is why the lowest number of cycles are generally run.

To properly evaluate the test results, keep in mind that a deviation of 5% in measured results of the "Min/Max test" is normal. This means that with an access time of 600 ms, the measured results can range from 585 ms to 615 ms.

The HyperDisk SpeedKit from HyperWare

What is SpeedKit?



The HyperDisk SpeedKit consists of three DOS-based PC speed-up utilities:

- HyperDisk
- HyperKey
- HyperScreen

These utilities increase the efficiency of your personal computer dramatically. You can use them together or separately to customize your PC to fit your personal work style.

Warning! Before installing HyperWare, we recommend you backup your hard drive AND read all documentation included in the CACHE directory. Follow all instructions carefully. If you are in doubt as to your expertise with this sophisticated utility package, do not install it.

HyperDisk

HyperDisk is an efficient disk caching utility. HyperDisk can improve hard disk system performance by up to 1000 percent, while simultaneously prolonging the lifetime of your drive by reducing the wear and tear caused by frequent and redundant access.

How Caching Works

Disk caching is simply keeping often-read items readily accessible in your computer's Random Access Memory, or RAM. Accessing information from RAM is far faster than accessing it from disk memory. A disk cache maintains a history of data usage, and when the buffer is full, the oldest or least-used data in RAM is replaced with new data. You never run out of space because it is automatically reused to hold your most recent requests.

How HyperDisk Works

When your application issues a disk read operation, HyperDisk intercepts the request, copies the data from the disk to its buffer memory, and then passes the data on to the requesting application. HyperDisk copies all subsequent requests for the same data from its buffer memory to the requesting application.

When your application issues a disk write operation, HyperDisk compares the new data to the data already in the cache memory. If it is the same data, the time-consuming disk update is bypassed. HyperDisk copies only active data (data you are actually using) to the buffer, thus providing much more efficient use of your machine's RAM.

HyperKey

HyperKey is a powerful keyboard enhancement package that allows each user to customize all keyboard functions including the type-ahead buffer size, key repeat rate, length of delay before a key begins repeating, keyboard clicking sounds, and Touch Shifting for one-finger typing. By adjusting these functions you can enter data at your own rate.

HyperScreen

HyperScreen is a video enhancement tool that gives you the most power and versatility from your existing video hardware. HyperScreen's state-of-the-art software provides automatic screen blanking to keep images from burning into your display terminal, manual screen blanking at the touch of a key to maintain the confidentiality of your on- screen documents, and video basic input/output system (BIOS) speedup to increase display speed in all text modes.

HyperDisk SpeedKit from HyperWare. The SpeedKit includes HyperDisk, HyperKey and HyperScreen. HyperWare, HyperDisk, HyperKey, HyperScreen, Touch Shifting, and SpeedKit are trademarks of Roger Cross. Program and Documentation Copyright 1987-1993 by Roger Cross. All Rights Reserved.

Nitro - Explosive Animations

The 100+ animations were included on the companion CD-ROM were created by dozens of skilled animators throughout the world. In researching this project, we feel the animations on the companion CD-ROM are in the public domain and therefore have included them for your computing pleasure. All these animations are available throughout the world on BBSes (bulletin board systems) including such commercial services as CompuServe. If you find other animations which can be played with the AVI player AutoDesk Animation Player, enjoy.

Nitro lets you play the animations included on the companion CD-ROM. You can also create your own customized "shows" from any of the animations on the CD-ROM.

Running Nitro

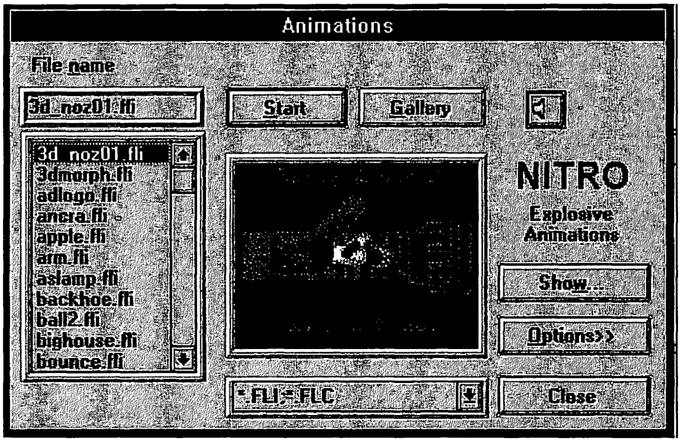
There are two ways to start Nitro.

1. Choose **Animation** from the main Menu. Choose **NITRO** from the selections.

2. Start Windows. Choose the **Run** command from the **File** menu. Type in the drive letter for your CD-ROM drive into the command line, followed by NITRO.EXE. Click OK to run the NITRO.EXE file.

To see all the animations played on your computer screen in a continuous loop, select START FILM.

To display individual animations or to access the CREATE SHOW, click on the SHOW MANAGER button. This screen allows you to play animations one at a time and configure your play and display modes.



The buttons have the following functions:

Start
: Starts the highlighted '.fli' animation file.

Gallery
: Displays a bitmap image of all animation files.

Loudspeaker
: Turns sound on or off.

Show...
: Opens the Create Show dialog box.

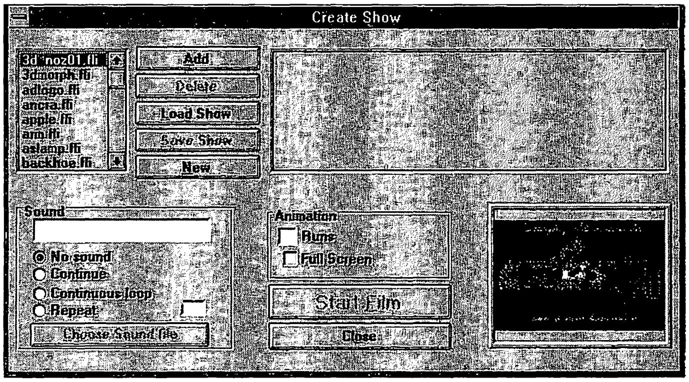
Options>>
: Lets you change the memory and display modes of Nitro.

Close
: Closes this window and returns you to the main Nitro screen.

How to create your own shows

Nitro allows you to create a 'script' or Show list that you design to play sounds and animations. We have included two sample 'scripts' for you. ALL.AAS is the 'script' to run all the animations continuously and WATCH.AAS is a short script to watch as well.

To create your own animation sequences in a specific order, select one or more animations from the examples listed in the sliding file display. As you select these files, they are added to the display box one after the other. You also have the option to add a sound to the animation by clicking CHOOSE SOUND FILE. After you choose a sound wave to be played with an animation, it will automatically place this information in the dialog box.



[Add]
Adds animations to the Show list.

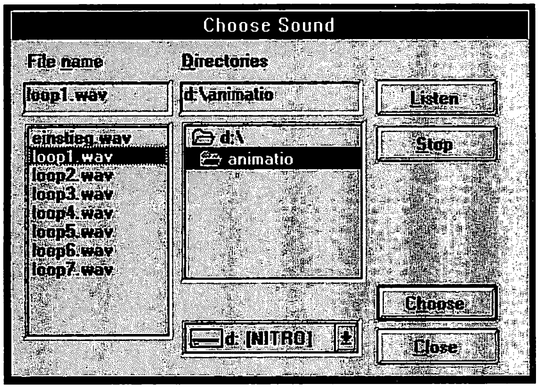
[Delete]
Deletes animations from the show.

[Load Show]
Loads ready-to-run shows from the CD.

[Save Show]
Saves your custom made shows.

[New]
Clears the Show list.

Sound
Opens the Choose Sound window and allows you to choose a sound and/or Listen to it.



Start Film

Plays the scripted animation sequence in the Show list box.

Close

Closes the CREATE SHOW window.

(Full Screen check box selected)

Animations presented on a full screen.

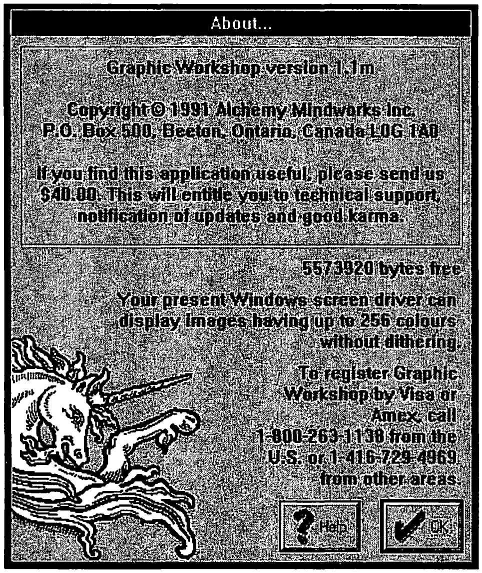
Definition Of Shareware

Shareware distribution gives users a chance to try software before buying it. If you try a shareware program and continue using it, you're asked to register it. Copyright laws apply to both shareware and commercial software. The copyright holder retains all rights; a few specific exceptions are stated below. Shareware authors are accomplished programmers, like other commercial authors. Many programs are of comparable quality. The main difference is the method of distribution. The author specifically grants the right to copy and distribute the software, either to all or to a specific group. For example, some authors require written permission before a commercial vendor may distribute their shareware.

Shareware is a distribution method, not a type of software. You should choose software that suits your needs and pocketbook, whether it's retail or shareware. The shareware system makes fitting your needs convenient, because you can try before you buy. And because the overhead is lower, prices are usually lower. Shareware has the ultimate money-back guarantee -- if you don't use the product, you don't pay for it.

Again, if you like the shareware program and use it, please register.

Graphic Workshop for Windows



Graphic Workshop is a powerful, yet easy-to-use program for working with computer bitmapped graphic files. It will handle most of the popular file formats, as listed in the contents section of this document. Graphic Workshop is a simple, menu driven environment which will let you perform the following operations on graphic files: View them, Convert between any two formats (with a few restrictions), Print them, Dither the color ones to black and white, Reverse them, Rotate and flip them, Scale them, Reduce the number of colors in them and do color dithering, Sharpen, soften and otherwise wreak special effects on them, Crop them down to smaller files, Adjust the brightness, contrast and color balance of the color ones, Capture Windows screens or portions thereof.

Graphic Workshop for Windows requires Windows 3.1 or higher. A minimum of four megabytes of memory is recommended. Note that if you have four megabytes in your system, but a large part of it is tied up in a RAM disk, a disk cache, as EMS or in some other form which Windows cannot address, Graphic Workshop may be unable to run. Graphic Workshop for Windows has been rewritten as Release 1.1. If you've used an older version of the software, you'll find this one considerably different.

Graphic Workshop for Windows has become more powerful, but it hasn't gotten more expensive. You can register your copy for $40.00. If you'll be registering by credit card, call our toll free order line at 1-800-263-1128. Complete information about registering Graphic Workshop for Windows and contacting

Alchemy Mindworks can be found in the GWS documentation, and in graphic Workshop's Help function. Graphic Workshop, Desktop Paint, Image Gallery and GrafCat are trademarks of Alchemy Mindworks Inc.

To install Graphic Workshop for Windows, choose Graphic icon then choose Graphic Workshop icon.

Sony Digital Audio Disc Corporation (DADC)

At CD-ROM "press time" SONY's D.A.D.C. division (Terre Haute, IN) has included an outstanding "movie" for you. This movie is an excellent overview of how Sony makes CDs. To run this movie, at the DOS prompt type:

`CD x:SONY` Enter

(where xx is your CD drive letter).

`Next, type SETUP` Enter.

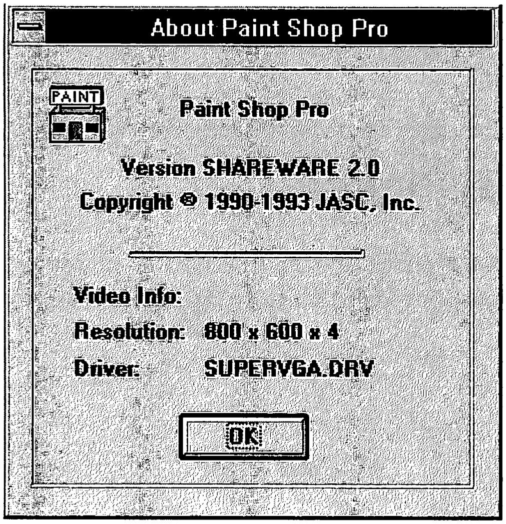
If you want to run from Windows, select **Run** from the **File** menu of the Program Manager and type:

`x:\SONY\SETUP.EXE` Enter

(where x is your CD drive letter)

Enjoy and thank you SONY!

Paint Shop Pro



Paint Shop Pro is a Windows program that allows you to work with multiple images at a time. With Paint Shop Pro you can display, convert, alter, scan and print images. In addition, it is a screen capture utility.

Paint Shop Pro supports the file formats; BMP, CLP, CUT, DIB, EPS, GIF, IFF, IMG, JAS, JIF, JPG (JPEG), LBM, MAC, MSP, PCD (Kodak Photo CD), PIC, PCX, RAS, RLE, TGA, TIFF, WMF and WPG. Paint Shop Pro includes a batch conversion for those large conversion jobs. Scan your images directly into Paint Shop Pro using any TWAIN-compliant scanner. Make your adjustments, then save the image to exactly the file type you will need. Add image support to your other applications with Paint Shop Pro's OLE server support.

Paint Shop Pro displays images in many ways, including zooming in and out. Altering the image includes flipping, mirroring, rotating in one-degree increments, resizing, resampling, cropping, adding a border and 19 standard filters. Paint Shop Pro supports user defined filters to allow you to create, edit, delete and apply your own filters.

You can also work with the colors of an image by adjusting the brightness/contrast, highlight/shadow, gamma correction and red/green/blue. Alter the colors by grayscaling, solarizing and creating a negative. Palette manipulation allows you to change individual color values, save and load palettes. Change the image type by increasing or decreasing the color depth.

Winner - 1992 Shareware Industry Awards

In order to keep the size of the Shareware version of Paint Shop Pro reasonable no user's manual is provided. You will find that ALL menu items and associated dialog boxes, along with general information, is provided on-line using the HELP-INDEX menu option of the program. When you purchase the licensed version of Paint Shop Pro you will receive the fully illustrated, perfect bound User's Guide.

ASP Ombudsman Policy. This program is produced by a member of the Association of Shareware Professionals (ASP). ASP wants to make sure that the shareware principle works for you. If you are unable to resolve a shareware-related problem with an ASP member by contacting the member directly, ASP may be able to help. The ASP Ombudsman can help you resolve a dispute or problem with an ASP member, but does not provide technical support for members' products. Please write to the ASP Ombudsman at 545 Grover Road, Muskegon, MI 49442-9427 or send a CompuServe message via CompuServe Mail to ASP Ombudsman 70007,3536

You may use the shareware version of Paint Shop Pro for a 30 day trial period. If you would like to continue to use Paint Shop Pro after the 30 day trial period, you are required to purchase the licensed version of Paint Shop Pro. JASC, Inc., 10901 Red Circle Drive, Suite 340, Minnetonka, MN 55343 USA

(612) 930-9171 (9am to 5pm USA central time)

To install PhotoLab, choose Graphic icon then choose Graphic Workshop icon.

Photo Show 3D

This package contains the Windows 3.1 Screen Saver, Photo Show 3D (Version 1.0), by Progressive Logic. PHOTO SHOW 3D is a Windows 3.1 screen saver that maps a 256 color GIF or PCX image to the surface of a 3D object and tumbles it across the screen. It requires a 386 or better processor and a 256 color Windows video driver. Registration includes a free photo scan, a copy of the latest registered version, an assortment of sample image files and a sample Winzle, a great Windows image puzzle game by Cascoly Software.

Photo Show 3D is a shareware program. This evaluation version includes all features of the program, and is not crippled in any way. You may use it for up to 30 days, without charge (see the on-line help for more details). If you like the program, and wish to continue its use after this evaluation period, you are required to pay for the program (see REGISTER.TXT for more details). Any fee you may have paid to others (disk vendors, dealers, etc.) to obtain this evaluation version was a fee for their copying and distribution services, rather than a payment for continued use of the program.

Thank you for choosing Photo Show 3D.

Required Configuration: Processor Family: Intel 80x86 (minimum 80386) 16 MHz; Microsoft Windows 3.1; 2MB RAM; VESA Super VGA (SVGA, VESA) and a 256 color Windows video driver!

Installation

Thank you for choosing Photo Show 3D.

Since there is an extensive on-line help that you may access from the configuration dialog, this file contains only the information needed to get you started.

You use Program Manager to install Photo Show 3D. From the menu, select "File" and then "Run". Next you type "x:PS3DINST" replacing x with the drive the floppy is in (usually A). If you have downloaded PS3D from a BBS or an on-line service such as Compuserve it will probably be on your hard drive so you would then also include the name of the directory it is in.

If there are any problems, try running PS3DINST a second time just in case the target directory was entered incorrectly. If there is still a problem, just make sure the files PS3D*.SCR, PS3D*.HLP and CTL3DV2.DLL are located in the Windows directory and follow the instructions in the next paragraph to select PS3D as the active screen saver.

After it's installed you must run Windows and use the Control Panel to select and configure Photo Show 3D. To do this you must first run the Control Panel. Usually it's in the Main group. Then from the Control Panel you must run Desktop. In the Desktop setup dialog you first select Photo Show 3D as the current screen saver and then click on the Setup button to bring up the Photo Show 3D Configuration Dialog. Last but not least, click on the Help button and you're on your way!

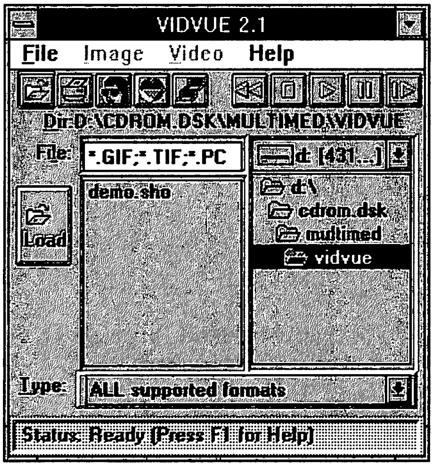
The files PS3DINST.*, *.DOC, *.SDI and *.DIZ are no longer needed after the installation is complete and may be deleted. The only files that are actually REQUIRED to run Photo Show 3D are PS3D*.SCR, PS3D*.HLP and CTL3DV2.DLL, but please keep the *.TXT files also so that you may register PS3D or order more images to use with PS3D or your other favorite programs.

I hope you enjoy Photo Show 3D and will help to further its growth by sharing the original unregistered version, PS3D*.ZIP, with your friends.

We also offer a photo scanning service so you may use your favorite photos with Photo Show 3D. An order form and price list are included with this package. See PHOTSCAN.TXT

Also included is an order form for image sets from Cascoly Software. Cascoly provides PCX files that you can use for Puzzles, Screen Savers or Wall Paper. Each set contains 6 images, individually selected and digitally enhanced for maximum visual effect. All images are from original photography.

VIDVUE



VIDVUE is a Multimedia player/slideshow utility and image viewer/utility distributed as 100% functional shareware. It features outstanding ease-of-use; easy access to all controls with minimal keyboard input, mouse movements and learning. VIDVUE includes basic, intermediate and advanced Help functions. It is probably the ONLY Windows application to date, that fully supports full-featured GIF 87a and 89a files; features, probably, the fastest GIF decode to screen routines in Windows (written in assembly). It also includes full screen decoding option, fully supports JPG/JIF, BMP/DIB, PCX, TIFF, TGA and DCX formats with raster image support for WPG, EPS and PICT files.

Multimedia support includes AVI video, WAV audio, MIDI music and FLI/FLC animation files. AVI playback uses low level MCI video commands, allowing for full scalability in a sizeable window. Includes AVI frame grab function to import and save AVI frames to other formats.

Multimedia slideshows (with all supported formats) can be played with marked files and user-scripted slideshows. Features includes AutoDithering, AutoSizing, variable delays, variable backgrounds, special GIF processing, variable AVI scaling and other features PER SLIDE! Runs WAV and MID files while images are displayed. VIDVUE also converts file formats, sharpens, smoothens, adjusts contrast and brightness, resizes, flips/rotates, dithers, reduces colors, and converts to gray, among other features.

Requirements

Windows 3.1 running in Enhanced mode and VBRUN300.DLL.

Optional requirements

Installed Video for Windows (VFW) runtime for AVI playback. At CIS, browse for "VFW" to check availability, or check local BBSes for VFWRUN.ZIP.

Important note

Please ensure that VBRUN300.DLL is in your Windows directory or Windows System sub-directory before running VVUSETUP.EXE from Windows.

To install, select **Run** from the Program Manager menu bar then enter the path name and "VVUSETUP". For example, if you extracted the files into "e:\test" then type "e:\test\vvusetup". VIDVUE's Setup now provides an option to setup ALL files in it's specified application directory.

For more information

Lawrence Gozum
100 Oriole Parkway #310
Toronto, Ontario Canada
M5P 2G8

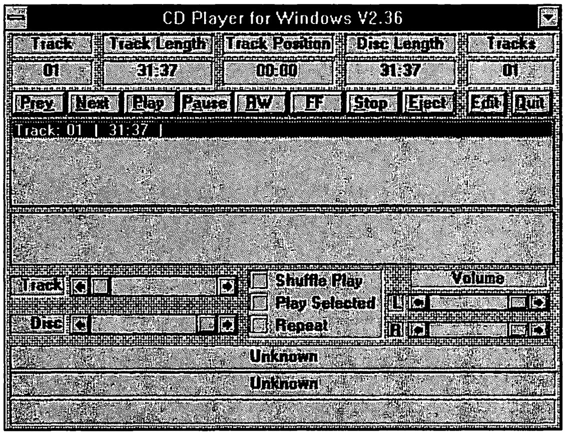
Play Directory

Lucas Arts Software's Demonstrations of Indiana Jones and the Fate of Atlantis, and The Day of the Tenacle.

We have included two exciting and entertaining product demonstrations from the wizards at Lucas Arts, The Day of the Tenacle and Indiana Jones and the Fate of Atlantis. To run The Day of the Tenacle go to your Program Manager. Select FILE, RUN, BROWSE, SELECT CD DRIVE, SELECT PLAY directory, SELECT either DOTTDEMO, INDYDEMO directories.

Sound Directory

CD Player for Windows



CD Player is a compact disc player and database for Windows. This program works with any CD-ROM drive that has audio capabilities. In addition, the correct Windows drivers and MSCDEX.EXE are required.

To install CD Player copy CDPLAYER.EXE to a directory on your hard disk. Next copy BWCC.DLL to your "\WINDOWS\SYSTEM" directory. Two files are created in the directory from which CDPLAYER.EXE is run.

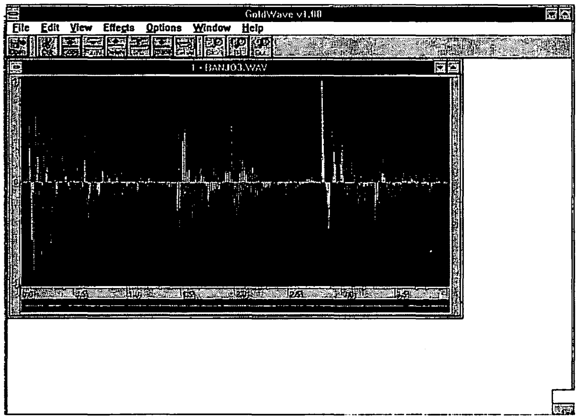
These files are CDPLAYER.CFG and CDPLAYER.DAT. If you don't mind these files residing in your "Windows" directory you may put CDPLAYER.EXE there instead of in its own directory.

Version 2.34, (c)copyright 1993,94 by Brian E. Baker

For more information

Brian Baker
3010 West Mirage Court
Meridian, ID 83642

GoldWave



GoldWave™ is a Microsoft Windows™ 3.1 application that uses the standard audio interface to create a full digital editing and effects studio. GoldWave includes several features not found in current audio applications, such as an expression evaluator, an oscilloscope, a device controls window, and independent left/right channel editing of stereo sound files.

The expression evaluator allows you to generate everything from simple sine waves to band-pass filters. It supports over 20 common functions and operations.

The oscilloscope displays sounds as they are being played or recorded. You can see what the sound looks like.

The device controls window contains buttons for playback, recording, volume, etc. The window is separate from GoldWave's main window and allows more flexible control of audio devices.

Along with the standard editing functions of cut, copy and paste, GoldWave has several audio effects built in. These include reverse, echo, fade out, volume, and silence. GoldWave employs a multiple document interface (MDI) so up to 5 sounds can be loaded at one time, making file-to-file editing easy. The sounds are displayed graphically and you can zoom in to see higher detail. In fact, you can zoom in far enough so that a single sample is graphed.

This manual presents and explains many features of GoldWave. The first part discusses system requirements, installation, etc. The second part covers the menu structure. Topics are covered in the order that they appear in the main menu. The final section provides general information (shareware concept, warranty, registering, etc.). Please be sure to read the shareware/warranty section! For users who are

unfamiliar with digital audio, Appendix A briefly introduces some of the fundamentals of digital sound. It also provides some solutions to common recording problems. This manual assumes that users are familiar with Microsoft Windows.

System requirements

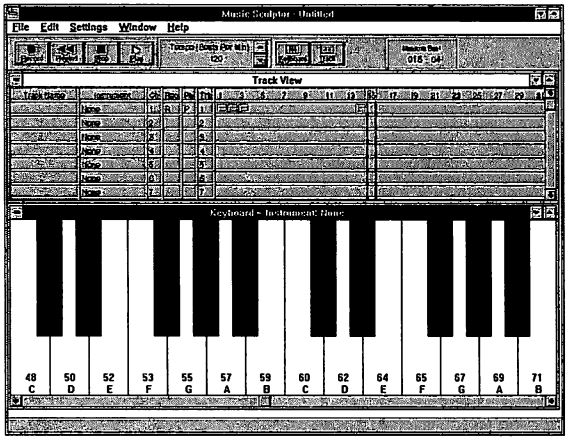
The minimum system requirements for GoldWave are:

- 16MHz 286 IBM PC or compatible
- Windows 3.1
- 4 Meg of RAM
- 1 Meg free on your hard disk
- Mouse
- EGA/VGA card and monitor
- MPC audio card
- Software driver (or PC speaker driver)
- Although a math processor is not required, it is recommended if you're using the expression evaluator often.

For more information

Chris Craig
PO Box 51
St Johns, Newfoundland Canada
A1C 5H5

Music Sculptor



Music Sculptor for Windows v1.4. Very easy to use MIDI sequencer with music keyboard window. Record, edit, and play music. Works with any Windows-compatible sound card or MIDI interface. Use with either external MIDI keyboard or music keyboard window which can be played using mouse or computer keyboard. Attractive and fully functional. MIDI files included.

Music Sculptor works with any synthesizer and sound card compatible with Windows 3.1 or later. (Note: Versions 1.0 and 1.5 of the Soundblaster Card don't support simultaneous use of the MIDI IN and MIDI OUT ports). Music Sculptor is a MIDI sequencer that allows you to:

Play MIDI songs - Record MIDI songs from an external MIDI input device such as a MIDI keyboard or from a Keyboard Window that can be played with the mouse or computer keyboard.

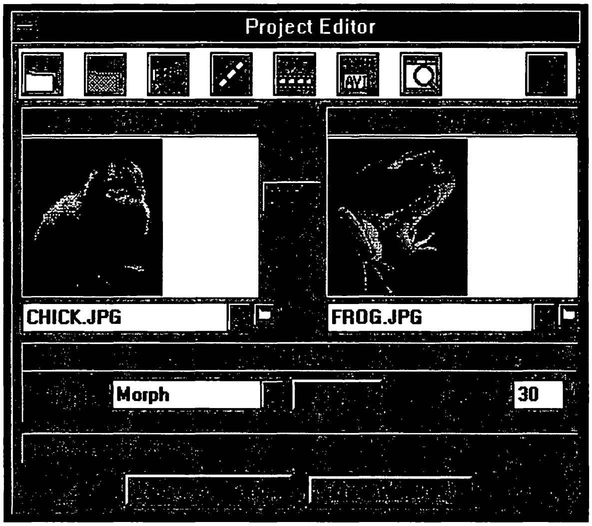
Edit music by:

- Cutting, copying, and pasting measures
- Adjusting volume and pitch
- Adjusting tempo and time signature
- Changing instruments
- Naming tracks
- Changing channels
- Open and Save standard midi files

Some sample public domain midi files are included.

For more information	Alpha Omega Software Box 61085 / Kensington Post Office Calgary, Alberta, Canada T2N 4S6

PhotoMorph



What's in the PhotoMorph DEMO?

This is the demo version of PhotoMorph 2. It is an award-winning special effects package for Windows. PhotoMorph allows you to combine and apply sophisticated special effects to video clips and bitmap images. PhotoMorph is used by professionals in the fields of desktop video, graphic design, multimedia production, and presentation graphics. PhotoMorph combines image editing, special effects, and digital video in one unbeatable product!

This demo version has been altered to remove some features found in the full version. This version cannot save any files, it has no clipboard functions, and it has no screen capture functions.

It's On The Companion CD-ROM

Appendix A

What Can You Do?

You can load demo projects using the left-most 'load projects' icon. You can preview them with the Preview tool (it looks like a magnifying glass). You can also play back AVI video files with the built-in AVI player. Be sure to install Video For Windows 1.1 or you won't be able to run these demos. Also be sure to check out the on-line help in PhotoMorph which describes the many new features and special effects.

A special note: the demo projects in PhotoMorph 2 use many layering techniques. This means that up to three different effects are used in a single 'clip'. When you preview a clip, the viewer defaults to showing only the first layer effect. To view the final result, click on the 123 button in the Project Manager to advance the effect from 1 to 2 and from 2 to 3. This will help avoid confusion. Happy Morphing from North Coast Software.

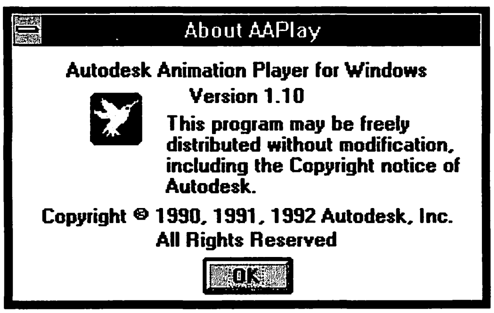
Where Can You Buy PhotoMorph?

You can purchase PhotoMorph directly from North Coast Software or from any of our US and International distributors. Purchase PhotoMorph from North Coast Software and receive either the Morphology 101 CD-ROM morphing library or the Mondo Morph disk FREE! That's a $40.00 value FREE when you purchase PhotoMorph for $149.95. FREE shipping in USA..

For more information

North Coast Software, Inc
PO Box 459
Barrington, NH 03825
(603) 664-6000 - phone
(603) 664-7872 - fax

THE AutoDesk Animator Player Program



The AutoDesk Animator Player program (AAPLAY.EXE) is a flic "projector" program that lets you play your animations or display your pictures. You can freely distribute this program, the file AAPLAY.DOC, and your animations to friends and business associates. The AAPLAY.DOC file contains instructions for using the AutoDesk Animator Player program.

The AutoDesk Animator Player can be used either interactively, with mouse or keyboard, or through scripted control. Scripted control uses an ASCII text file to instruct AutoDesk Animator Player to display a sequence of animations or pictures in any order, with assigned individual speeds and other special effects.

AutoDesk Animator Pro Player User's Guide (AAPLAYHI.EXE)

This program and its support files can be freely distributed by you. It is designed to let you deliver your presentations independently of AutoDesk Animator Pro. (Note: This program is functionally similar to a licensed utility called aniplay.exe, but aaplayhi.exe is freely distributable).

We would appreciate you giving copyright acknowledgment to AutoDesk somewhere in your presentation and have provided an opening credit for this purpose. This screen may be suppressed if necessary (see below). If you wish to include aaplayhi.exe as part of a commercial software product, we would appreciate copyright acknowledgment in the package and/or documentation.

The AutoDesk Animator Pro Player is Copyright 1991, AutoDesk, Inc.

With ANIPLAY for Windows, the animation player, you can play *.FLI and *.FLC files under Windows. ANIPLAY also lets you play script files with the AAS extension.

You can use the following switches with these script files:

-F Plays animation in full screen mode -N WAV file (Plays wave file simultaneously).

To start the animations from File Manager, copy the following files: AAPLAY.DLL ANIPLAY.EXE to a directory included in the DOS path. For example, you could copy the files to your Windows directory.

Also, you need to link the .FLI, .FLC and .AAS extensions with the ANIPLAY.EXE file.

AutoDesk MCI Animation driver

The **MCIAAP.DRV** file is a Windows MCI driver that adds Animation Player capability to your Windows 3.1 MCI interface. Once the driver is properly installed, you should be able to bring up the Media Player and see 'Animation1' as an additional option under the Device menu. This will verify that the driver is properly installed and now available for any application that can make use of MCI commands.

To install:

1. Copy the file MCIAAP.DRV to your \windows\system subdirectory.
2. Load the file SYSTEM.INI into an editor, such as notepad under Windows, or Edit under DOS 5.0.
3. Locate the line '[mci]' (without the apostrophe's). If this section does not exist, you may add it to the end of the file by adding a line that says '[mci]'.
4. Add the following line to this section:

   ```
   Animation1=mciaap.drv
   ```

5. If you are in Windows, you will need to exit out and restart Windows for this change to take effect.
6. Test the installation by bringing up the Media Player (part of the accessories group) and looking at the Device Menu. Animation1 should now be an option on that list.

Intel Smart Video Recorder

Microsoft Video for Windows RUNTIME

The Runtime software included in your Intel Smart Video Recorder package provides video playback capabilities for computers that do not have Video for Windows. If the target computer has Video for Windows installed, you should use the existing Media Player to try playing the files recorded with the Intel Smart Video Recorder. Install the Runtime files only if the playback is not adequate.

Technical Note: The Runtime setup backs up the existing SYSTEM.INI file to system.isv.

Intel Smart Video Recorder Video for Windows Run-Time

It's On The Companion CD-ROM

Appendix A

Video clips can be played on computers that do not have Microsoft Video for Windows. To play a video clip on a computer that does not have Video for Windows, follow these steps.

Note: The Microsoft Video for Windows disks also contain a set of runtime files. The Video for Windows runtime is not specific to the Intel Smart Video Recorder, while the version documented here has the latest INDEO (TM) video technology drivers. Release 3.0 Version 3.01.

Appendix B
Resource Guide For CD-ROM Vendors

Disc Duplicators

Digital Audio Disc Corporation
1800 N. Fruitridge Ave.
Terre Haute, IN 47804
Tel (812) 462-8100
FAX (812) 466-9125

Disc Manufacturing, Inc.
1409 Foulk Road
Suite 102
Wilmington, DE 19803
Tel (302) 479-2500
Fax (302) 479-2527
Toll Free (800) 433-DISC

IBM Software Mfg. Co.
6300 Diagonal Hwy
Boulder, CO 80301
Tel (303) 924-7365
Fax (303) 924-5570

JVC Disc America
359 Bravo Court
Bartlett, IL 60103
Tel (708) 213-8384
Fax (708) 213-8511

CD-ROM Recorder Manufactuers and Suppliers

Dataware Technolgies
222 Third Street
Cambridge, MA 02142
Tel (617) 621-0820
Fax (617) 621-0307

Eastman Kodak Co.
343 State Street
Rochester, NY 14650
Tel (716) 724-4000
Fax (716) 253-7443

JVC Information Products Co.
17811 Mitchell Ave
Irvine, CA 92714
Tel (714) 261-1292
Fax (714) 261-9690

Meridian Data, Inc.
5615 Scotts Valley Dr
Scotts Valley, CA 95066
Tel (408) 438-3100
Toll Free (800) 767-2537

Optical Media International
180 Knowles Dr
Los Gatos, CA 90530
Tel (408) 376-3511
FAX (408) 376-3519
Toll Free (800) 347-2664

Opti-Mag, Inc.
P.O. Box 10902
Wilmington, DE 19850-9998
Tel (302) 738-2903
Fax (302) 738-2904

Philips
4425 Arrows West Dr
Colorado Springs, CO 80907
Tel (719) 593-7900
Fax (719) 599-8713

Pinnacle Micro
19 Technology Drive
Irvine, CA 92718
Tel (800) 553-7070
Fax (714) 727-1913

Ricoh Corporation
5150 El Camino Real
Suite C-20
Los Gatos, CA 94022
Tel (415) 962-0433
Fax (415) 962-0441
Toll free (800) 955-FILE

Sony Electronic Publishing
One Lower Ragsdale Dr
Monterey, CA 93940
Tel (800) 654-8802

Trace
1040 East Brokaw Rd
San Jose, CA 95131-2393
Tel (408) 441-8040
Fax (408) 441-3399

Yamaha Systems
981 Ridder Park Dr
San Jose, CA 95131
Tel (408) 437-3133
Fax (408) 437-8791

Software providers

ASPI SCSI Software
Adaptec
691 S. Milpitas Blvd.
Milpitas, CA 95035
Tel (408) 945-8600

CorelSCSI Software $99.00
Corel Corporation
1600 Carling Ave
Ottawa, ONTARIO Canada K1Z 8R7
Tel (613) 728-1010

CD-R Mastering software
Incat Systems
1684 Dell Ave
Campbell, CA 95008
Tel (408) 370-2400
Toll free (800) 774-6228

CD*Gen Premastering Software
CD-ROM Strategies
6 Venture
Suite 208
Irvine, CA 92718
Tel (714) 453-1702
Fax (714) 453-1311

ISO Formatter
Publishers Data Service Corp
1 Lower Ragsdale Dr
Monterey, CA 93940
Tel (408) 372-2812
Fax (408) 372-9267

Useful Publications

CD-ROM/Multimedia Magazine
P.O.B. 2946
Plattsburgh, NY 12901-9863
Tel (514) 487-3242
Single issue $3.95

CD-ROM Professional
Pemberton Press
462 Danbury Road
Wilton, CT 06897
Single issue $9.95

Multimedia World
501 2nd Street
San Francisco, CA. 94107
Single issue $3.95

Nautilus Magazine
(monthly CD-ROM)
7001 Discovery Blvd.
Dublin, Ohio 43017
Sample issue $9.95

New Media Magazine
901 Mariner's Is. Blvd. Ste. 365
San Mateo, CA. 94404
Tel (415) 573-5170
Fax (415) 573-5131

PC Gamer
GP Publications
Ste. 210
1350 Old Bayshore Hwy
Burlingame, CA 94010

Appendix C

Manufacturing CD-ROMs

The production of CD-ROMs is based on the methods developed for manufacturing audio CDs. However, before a CD-ROM can be created, much work is required to prepare the information for the CD. The following is a list of the steps involved in producing a CD-ROM.

Premastering

Premastering usually includes a step to make sure the files adhere to the ISO 9660 standards. The data files may be text information, digitized images, graphics or executable program code. During premastering the EDC/ECC (error correction) information is added to the data.

Audio data is usually handled separately. The audio is sent to the service bureau on a separate digital tape. During premastering, these audio tracks are written to those areas of the CD-ROM that are set aside for this type of data.

The main job of premastering is to insert the error detection and error correction codes into the data stream. This adds 288 bytes of additional data to each 2K block or original. Synchronization bytes and header information are also placed at the front of each 2K block. Roughly speaking, after premastering, the image file is 15% larger than the original data.

Depending on the type of recorder, premastering is performed by software or hardware. Using a hardware encoder, the time for premastering 655 Meg of data is about 2 hours compared to about 5 hours for software only encoding.

Premastering also generates the time code, table of contents for the tracks and address fields for the Q-channel. The "data present/not present" information is also prepared for the P-channel. The table of contents which has yet to be written to the CD-ROM contains information about the total length, pauses and types of tracks.

Manufacturing CD-ROMs

Appendix C

Mastering

Recall that a CD-ROM is a plastic disc about 4.75 inches (12 cm) in diameter. The data is stored on one side of the disc and represented as microscopically encoded depressions called pits. There are roughly 4 to 5 billion pits per disc arranged in a spiral from the inner part of the disc to its outer edge. A reflective coating is applied to this side of the disc. A protective coating goes over the reflective surface.

Information stored on a CD-ROM is read optically without any direct contact with the reflective surface. A narrowly focused laser beam bounces off of the reflective layer and is modulated by the alternation between pit and land surfaces. A photoreceptor converts the reflected light into an electrical signal which is interpreted by the drive electronics as data. The laser beam diameter is focused from about 1 mm from the front of the disc to about 1/1000 mm into the pit. Under these conditions, a hair or tiny scratch on the disc surface has negligible effect on the data.

The data from premastering is transferred during mastering to a glass master. This is a finely polished glass disc, whose surface is comparable to an astronomical mirror found in quality telescopes. The disc is coated with a light sensitive chemical or photoresist. A special spin-coating process insures that the photoresist forms an absolutely uniform layer about 120 nanometers thick. The thickness of this layer determines the depth of the pits.

The key to the mastering process is the laser beam recorder. It is switched on and off in sequence with the premastered data stream. The modulated laser beam exposes the photosensitive layer on the glass disc. The exposure takes place in real time - in a spiral from the inside to the outside of the disc at exactly the same speed and way that the CD-ROM will be replayed.

Next a chemical process is used to create a die or stamper. The glass master is etched in a chemical solution that reveals the exposed areas and produces the first pits. Electronic instruments control the development and automatically halt the process after reaching a prescribed pit depth. The structure of the walls of the pits are also monitored to assure quality.

When the glass master dries, it is coated with a thin layer of silver 100 nanometers thick. After the silver coating, a special disk master player is used to read the data. The production master is thoroughly tested, since its quality affects all subsequent steps. The error detection code can be checked to identify errors that may have been introduced by the mastering process itself.

Quality is ensured only if all processes take place under exacting conditions. The air must be conditioned and very "clean" with not more than 100 particles larger than .5 micrometers per 28 liters allowed. The water used for cleaning the glass discs must be deionized and sterilized, so after this treatment, the water becomes an insulator. As you might imagine, a glass master disc is too fragile to be used to press the pits into the plastic body of a CD-ROM disc. In the next stage, the glass master is turned into a die or stamper.

An electrolytic bath using a nickel anode changes the silver layer of the glass master to a cathode. As the electrical current is applied, a layer of nickel grows on the glass master. After the nickel layer is separated from the glass master it is known as the original or "father". Since the glass master is destroyed along the way, a new master must be made if there are subsequent quality problems with the father.

The "father" is like a negative, meaning that the pits have been turned into elevations. You can actually duplicate CD-ROMs using the "father". However, to avoid the risk of destroying the original and requiring a costly new master, a second electroplate, the "mother" is produced from the original. The metal stampers ("sons" and "daughters") are then made from the "mother" in a third step.

Like the original, these stampers are also negatives and are used for the actual duplication.

Duplication

Mass duplication of a CD-ROM involves these steps: Molding the plastic discs, applying the reflective surface and affixing the label. A laser must pass through the plastic of a disc twice to read the data. Many highly technical factors affect the choice of plastic material that is used: optical purity, degree of translucence, acceptable refraction index. The material also has to meet certain manufacturing criteria such as a low viscosity at high temperatures to maintain the pit structure. Polycarbonate meets these requirements.

CD-ROM discs can be manufactured using either a mold stamping process or an injection mold process. In mold stamping, the pits are pressed into a newly molded polycarbonate disc. In injection molding, the polycarbonate is heated into the pattern directly. With either process, the cooled polycarbonate disc contains all the data.

The side containing the data is coated with an atomized aluminum to a thickness 40 to 50 nanometer. Coating the disk like this is called sputtering. To protect the aluminum layer against oxidation and other effects, the disc is sealed with lacquer. Its done using spincoating, where the lacquer is dropped into the middle of a spinning disc which lays down a uniform layer about 10 micrometers thick.

After the lacquer hardens, the data has become protected against external effects. Stamping, metallization and protecting are all done under clean-room conditions. All other operations can be performed without additional precautions. Next, a label is printed on the lacquer layer. There are two common ways to print a label. In the U.S., the preferred method is screen printing, similar to the way custom T-shirts are printed. In Europe, the buffer printing is more widespread. For buffer printing, an ink color is taken from a printing block with a rubber stamp and is transferred to the CD.

Illustration on the following page is included courtesy of:	**Disc Manufacturing, Inc.** **1409 Foulk Road Ste 102** **Wilimgton, DE 19803** **1-800-433-DISC**

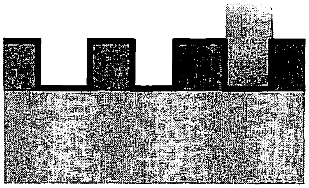
How CDs Are Reproduced

Glass Master

From the customer's data, the CD Glass Master is produced.

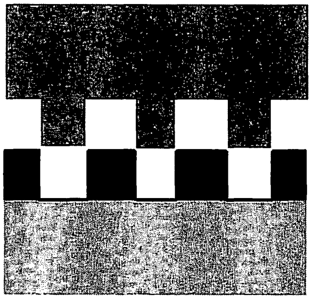
An optically ground glass disc is coated with a 1/10th micron thick layer of Photoresist which is then exposed by a laser. The laser "writes" or exposes a pattern of pits on his thin layer, transferring the information from the master image.

The disc is developed (the exposed parts are etched away), it is silvered, resulting in the actual pit structure of the finished disc.



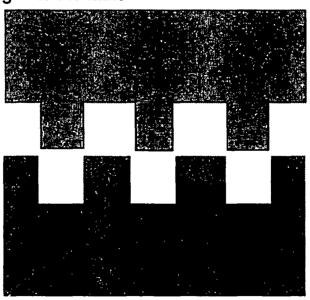
Father

The master is then electroplated with nickel which, when separated from the master, forms a metal negative or "father".



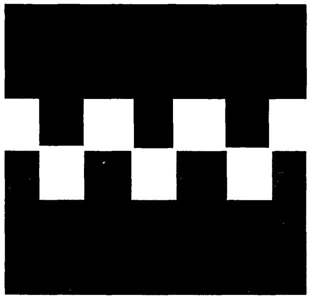
Mother

The father could be used to replicate CDs but would wear out too soon. Instead, several "mothers" (or positives) are made by plating onto the father.



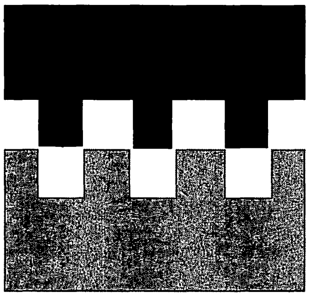
Stamper

In the third plating stage, each mother is used to create a number of stampers, which are actually used to mold the pit structure onto the CDs.



Clear Disc

Compact discs are made similarly to conventional records using injection molding techniques and a stamper.



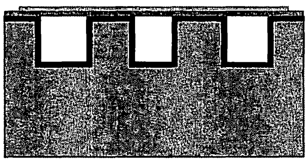
CD-ROM Disc

From the customer's data, the CD Glass Master is produced.

The information surface is coated with a micron thick layer of aluminum to provide a reflective surface.

This is the surface which is actually read by a CD Player. The reflective surface is then protected with a lacquer coating.

The disc label is then printed directly onto the disc.



Appendix D

CD-ROM Standards/Formats

APPENDIX D

Yellow Book

The Yellow Book: CD-ROM defines the physical format of the Compact Disc Read Only Memory standard. This means that compact discs are read-only and can not be written to by personal computers. The CD-ROM track types defined are: CD-Audio, CD-ROM mode 1 (for computer data) and CD-ROM mode 2 (for compressed audio/video/picture data). The difference between the Red Book and the Yellow Book is a redefinition of the 2352 byte Red Book data area.

Green Book

The Green Book standard refers to Philips' Compact Disc Interactive (CD-I) Media standard. This standard is for the interleaving of computer data and compressed audio on the same track. CD-I discs can not be played on audio players. CD-I systems are connected to television sets.

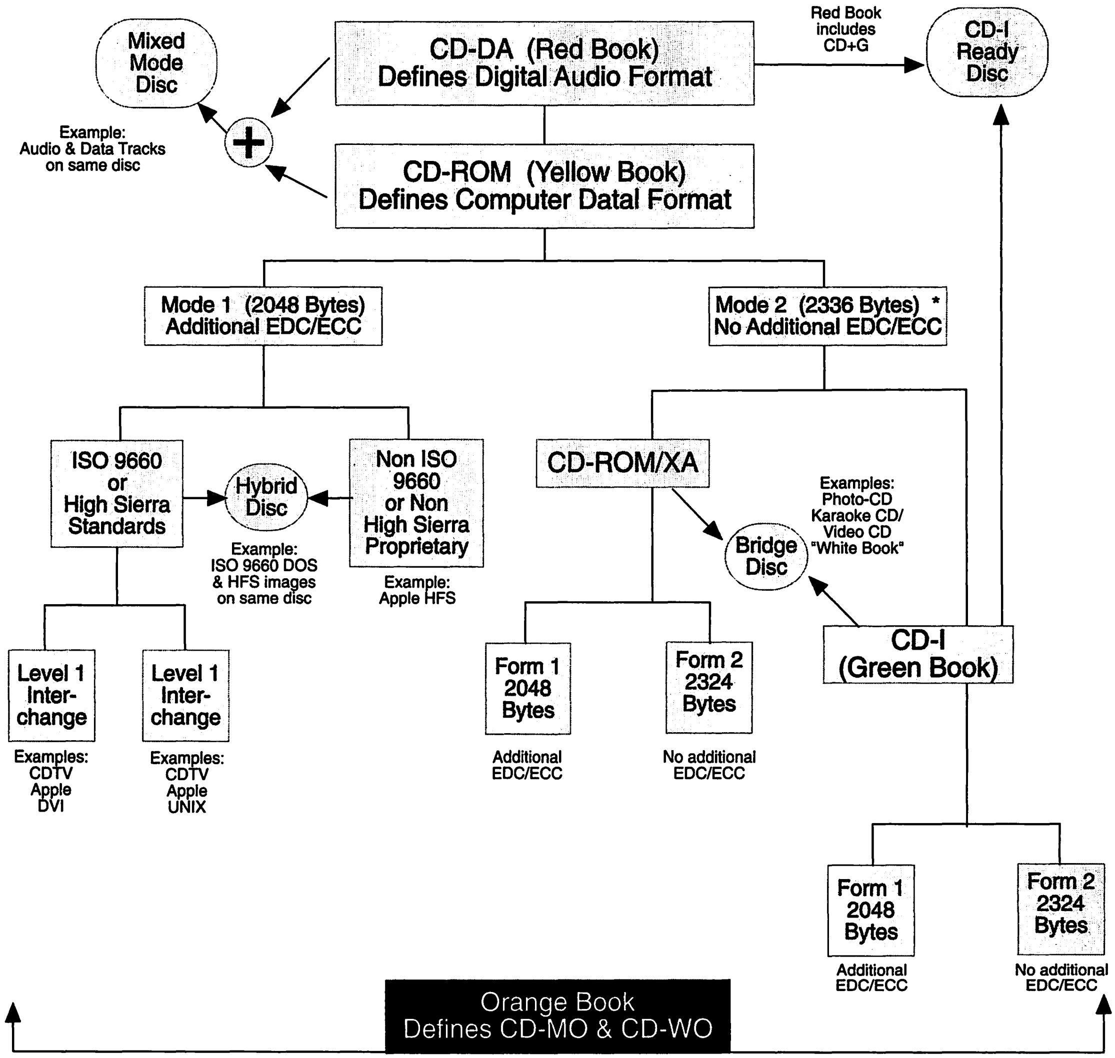
Orange Book

The Orange Book defines new standards of CD that allows you to write audio and/or data to the disc. There are two standards in the book: CD-MO (Compact Disc - Magneto Optical) and describes the information on a CD-MO disc; and the CD - WO (Compact Disc - Write Once) which is also the CD-R (Compact Disc - Recordable) disc that is used for mastering a CD for production.

White Book

The White Book defines the Video CD standard which was developed by Philips and JVC to be used in applications where the combination of full motion video and audio are required. It is also supported by SONY and Matsushita. This technology uses the ISO MPEG 1 standards for compressing video and audio down by 50 to 1 of their original size. The current MPEG 2 standard is a compatible extension of MPEG 1, however, MPEG 2 allows higher transmission rates and resolution applications.

Diagram of CD Standards and Formats



* The information located below the Mode 1 block (ISO 9660 & Non ISO 9660) can also apply to a Mode 2 disc

Illustration on this page is included courtesy of: **Disc Manufacturing, Inc. 1409 Foulk Road Ste 102 Wilmington, DE 19803 1-800-433-DISC**

Appendix E Glossary

3DO (3-Dimensional Optics)

Medium for games and entertainment that also uses CDs invented by 3DO Corporation, CA.

Access Time

Access time is a measurement for the speed at which data can be located, for example, on a CD ROM drive. Since an access time can vary greatly, depending on how far the read head has to move over the entire surface of the CD, a mean access time is always specified.

We recommend CD ROM drives have a mean access time of 200 milliseconds or less.

Active speakers

Active speakers are speakers with a built-in amplifier which can be connected directly to the audio output of a sound card, for example. Active speakers are usually smaller than passive speakers.

ADC (Analog Digital Converter)

You digitize analog input signals with an AD converter.

Digitizing audio data is referred to as sampling.

See also: DAC

Additive Color Mixture

The primary colors of red, green and blue are mixed together in this process. The resulting color is white. Television is an example of this procedure.

Additive primary colors

On the basis of additive color mixing, you can produce the color white by mixing the primary colors of red, green and blue.

AdLib Sound card

The sound cards of AdLib Corporation, Canada, were among the first on the market and helped establish a 'standard' for PC sound boards that is still used today. Similar to the popular SoundBlaster cards manufactured by Creative Labs, Inc., CA.

ADPCM (Adaptive Differential Pulse Code Modulation)

This is a procedure for compressing audio data very tightly. In coding the audio data, absolute numerical values are not stored, but rather the differences. In addition, the procedure reduces the scan rate and sampling depth in various selectable levels. Depending on the level you select, up to 19 hours of audio are possible on a CD.

See also: Scan rate, Sampling depth

Alpha Chip

Family of advanced, high performance microprocessors developed by DEC. Works with clock frequencies of up to 300 MHz.

Analog Signal

Analog signals can take on any shape or size. Analog signals must be converted to digital data for processing on a PC.

Animation

Animation is a succession of moving diagrams, pictures or cartoons, usually for entertainment purposes or presentations.

ASCII

Abbreviation for the American Standard Code for Information Interchange. This refers to a standard combining letters, numbers and special characters. There are two types of ASCII code, the 7-Bit ASCII code, which is made up of 128 characters that are assigned numbers 0 to 127, and IBM's 8-Bit ASCII code which contains 256 characters.

ASPI (Advanced SCSI Programming Interface)

Driver standard for SCSI drives developed by Adaptec Corporation, a peripheral manufacturer.

Audio-CD

see: CD-DA

Authoring system

Software that allows users to create multimedia programs and presentations without using programming languages.

AVI (Audio Video Interleave)

File format for video files in Windows invented by Microsoft.

Base Resolution

On a Photo CD, the images are stored in various resolutions. The standard format is 768 x 512 pixels. Different variations of this resolution are stored on the Photo CD, based on this format.

The following lists the formats that A PCD file consists of the following formats:

Base/16, 128 lines x 192 pixels, resolution at 1/16 of the information of the normal image.

Base/4, 256 lines x 384 pixels, resolution at 1/4 of the informaiton of the normal image.

Base, 512 lines x 768 pixels, normal image.

4 Base, 1024 lines x 1536 pixels, resolution at 4 times the information of the normal image.

16 Base, 2048 lines x 3072 pixels, resolution at 16 times the information of the normal image.

64 Base, 4092 lines x 6144 pixels, resolution at 64 times the information of the normal image, Pro Photo CD resolution.

Base, Base/4 and Base/16 images are uncompressed.

4 Base and 16 Base images are stored on the CD in compressed format.

Bit (Binary digit)

Smallest memory cell in the PC world. A bit can take on two different values interpreted as 0 or 1.

Bitmap

Bitmaps are graphics composed of pixels. The depth of color is crucial for the number of colors. In a black and white graphic, only one bit is required for each pixel (color depth of 1 bit), while a color graphic can require as many as 24 bits per pixel. 24 bit color depth is also referred to as TrueColor.

Blue Book

Future CD ROM specification describing CD ROMS with a total capacity of 6.5 Gigabytes.

BMP format

BMP format is a bitmap format that saves images according to the bit pattern. Windows uses BMP format more than any other program. There are many different bitmap formats, but most of them are very similar. Along with the standard BMP format, there is also DIB format (almost identical to BMP format) and RDIB format, which is used by Windows Multimedia Extensions.

There has been a compression procedure for bitmap files ever since Windows 3.1 was released. RLE format is actually just a compressed version of DIB format.

Bridge Disc

A CD that can be used both in a CD ROM drive and in a CD-I player. For example, a Photo CD is a bridge disc.

Byte

A unit of information which is composed of 8 bits. A byte is interpreted as a character.

On a CD, a byte consists of 14 channel-bits.

See also: Channel-Bit

Cache

Cache is buffer memory and is used to improve performance. You can reduce access time by storing data temporarily in the cache. SMARTDRV.EXE is a cache program that places data read to this buffer memory.

Caddy

A caddy is a special plastic case, into which you place a CD ROM before inserting it into the drive. Some systems require the use of a caddy.

CAV-Storage (Constant Angular Velocity)

Information coding technique in which storage media rotate at a constant speed. Used with hard drives or diskettes. The information is located in a number of concentric circles, called tracks, and sectors.

See also: CLV-Storage, rotation speed

CCD

(Acronym for Charge Coupled Device) The term for a chip that converts light into electronic signals. Modern video cameras use these chips for image reception, some scanners also use these chips.

CD (Compact Disc)

The famous silver disc developed by SONY and PHILIPS which stores data in digital form. A laser beam in the CD drive scans (reads) the disc. CD also refers to CD ROMs for computers.

CD+G

An audio CD, with additional information stored on it, such as text or graphics. However, a special CD player is required to access the data.

CD-A

(Acronym for Compact Disc Audio) The term refers to the audio standard for a 60 minute, 4.75 inch (12 cm) CD.

CD-DA (Compact Disc Digital Audio)

Standard for digital audio CDs. The specification for CD-DA was described in the Red Book.

CD-DAs have a maximum music capacity of either 63 or 74 minutes.

CD-EB (Electronic Book)

The CD-EB is an 8 centimeter CD currently incompatible with the normal CD ROM standard. A special portable player (such as SONY's) is required to read these CDs. They contain encyclopedias, reference works etc.

CD-I (Compact Disc Interactive)

The definitions for CD-I are in the Green Book. CD-I is independent of the normal CD ROM standard and will not play in a CD ROM drive. You don't need a PC to run a CD-I player. You can connect a CD-I player to a television set to play back multimedia data.

CD-MIDI

An audio CD on which additional MIDI information is stored. However, CD-MIDIs require special playback devices that are rare.

See also: CD+G

CD-MO (Compact Disc Magnetic Optical)

The technology of CD-MO-(Magneto Optical) drives is a combination of magnetic and optical methods, and provides an erasable (multiple recordable) storage medium.

MO-discs and drives are available in 3.5-inch format (with a total capacity of 128 Meg or 256 Meg) and 5.25-inch format (650 Meg or 1.3 Gigabyte).

CD-R (CD-Recordable)

CD-ROM disk that can be recorded once with a CD Writer and then read in any CD ROM drive just like a normal CD ROM. Sometimes CD-Rs are also referred to as CD-WOs.

CD-ROM (Compact Disc - Read Only Memory)

Generic term encompassing all CDs in the computer field. The definitions for CD ROM in the more restricted sense are contained in the Yellow Book, and describe the classic CD ROM standard, as opposed to CD ROM/XA, for example. CD ROMs come in two sizes. There are 12 cm (4.75 inch) CD ROMs and 8 cm (3 inch) CD ROMs. CD ROMs are 1.2 mm thick. The information on a CD ROM is stored in a chain of pits and lands on a track running from the inside of the CD ROM to its outer edge. Because of optical scanning, the track density on the CD ROM can be held quite low: It amounts to 16,000 tracks per inch (in comparison, a diskette has 96 tracks per inch)

CD-ROM XA (CD-ROM Extended Architecture)

The enhancement of the classical CD ROM standard was also defined in the Yellow Book, although it was an expanded version of the Yellow Book. The CD-ROM/XA stand has three outstanding features: First, it has effective audio data compression (ADPCM), secondly, it has a modified sector format, and finally, it stands out because of interleaving, its ability to read out different types of data at the same time.

See also: ADPCM, Interleaving

CD-V (CD-Video)

Introduced to the market in 1987, the CD-V contains analog video signals in addition to digital audio information. The laserdisc is a variant of the CD-V. They cannot be played on PC CD-ROM drives.

See also: Laserdisc.

CD-WO/CD-WORM (Write Once Read Many)

Generic term for optical storage media that can be recorded once.

See also: CD-R, CD-MO

CD32

Successor of CDTV, game console manufactured by Commodore and based on the Amiga computer.

CDTV

(Acronym for Commodore Dynamic Total Vision) CD-playback station developed by Commodore for the consumer market. Using a separate Motorola 68000 processor, CDTV can be operated independently from the computer. CDTV has since been removed from the market.

Channel-Bits

Bits on a CD are referred to as channel bits. Like conventional bits, channel bits are interpreted as either 0 or 1; however, because of the information structure on the CD, 14 channel bits are required to represent one byte.

CLV-Storage (Constant Linear Velocity)

Method of information coding in which the storage media must be read at varying rotation speeds.

See also: Rotation speed, CAV-Storage

Compression

Compression of live video and still video is a very important task, since there are huge amounts of data to be dealt with in this field. Depending on the color display and the number of still shots for live video, more than 10 Meg of storage capacity are required for a one second recording. Standard compression procedures are JPEG for still video and MPEG for live video.

Controller

Controllers are internal PC boards that are necessary to connect peripheral devices such as hard drives to the PC.

CPU-Bus

Internal wiring system, used by the processor to exchange data with its environment.

See also: ISA-Bus, PCI-Bus

Crossplatform-CD

CDs that are compatible with different operating systems, such as Apple's MAC and IBM PCs and compatibles..

See also: Multi-CD-ROM

Cyberspace

Computer animated space.

See also: Virtual Reality

DAC (Digital Analog Converter)

A DAC converts digital information into an analog signal, e.g., to make noises that are in digital form on the CD audible. In a sense, a DA converter is the opposite of an AD converter.

See also: ADC

Data transfer rate

The data transfer rate from the CD ROM drive to the PC plays an important role in relation to the performance of the CD ROM drive. The data transfer rate of older CD ROM drives is 150K/s, while current drives have data transfer rates of 300K/s or 600K/s. CD ROM drives of the future will have even faster data transfer rates.

Digital

Digital data can be displayed in the form of discrete values. Digital information is processed in the computer as a sequence of bits, either 0 or 1. However, information can also be present in analog form.

Digital Signal

Information is output as chains of numeric values. The opposite of a digital signal is an analog signal.

Digitization

Digitization is the prerequisite to storing analog information digitally. Digitization converts analog signals to discrete values. Along with digitization of audio data, called sampling, images and video signals have to be digitized before storage. The most user-friendly method of digitizing images is to use a scanner, which converts the brightness and color information to a digital format.

Digitizing

To store analog signals on the PC you need to digitize them. You can digitize audio signals, graphic templates and videos. Usually refers to converting an image or audio sample into digital form the computer can read.

Digitizing analog audio signals is called sampling.

Dithering

With the help of dithering it is possible to display color images that have high amounts of color information with fewer colors. Colors are produced by mixing different-colored pixels.

DMA (Direct Memory Access)

A DMA controller makes internal data flow possible without using I/O base addresses.

Double-Speed drives

CD ROM drives with double rotation speed. Current double-speed drives attain a data transfer rate of 300K/s.

DVI (Digital Video Interface)

Developed by Intel, this technology makes it possible to digitize video recordings in real time and store the recordings as a compressed video file.

EPS

(Acronym for Encapsulated PostScript) Most word processors can read EPS format, but usually they cannot display the format on the screen. You can save images in EPS format, and then output them on a PostScript laser printer from any text program without losing much quality. Although EPS format is often used as an intermediate format for converting between different vector formats, this format is also used frequently in image processing or desktop publishing. Usually a TIFF image in lower resolution is bundled along with the EPS image so you can display it on the screen.

Floptical

In a floptical drive (Insite Peripherals, Inc.), information is stored magnetically, but the read/write head is guided by a laser beam that reads the disk.

Floptical drives can read both conventional 3½ inch diskettes and special FODs with a capacity of 20.8 Meg.

FM-Synthesis (Frequency Modulation)

Most sound cards have an FM synthesizer that is used to overlay several electric vibrations to create artificial sounds.

Form-1/Form-2

Two variations of sector division for the CD-ROM/XA system. Form-1 is used for data that are sensitive to error, while Form-2 is used for data less sensitive to error.

Frame

A frame is an information unit on the CD. Frames consist of 24 bytes. In computer graphics, one screen of data.

Frame Grabber

This is an add-on board that makes it possible to digitize analog video images and load them into the PC.

Frequency

Frequency refers to the rate of vibration of an analog signal. How high or low a given tone sounds depends on the number of pulses per second. This number of pulses is referred to as the tone's frequency. The unit of measure for frequency is Hertz (Hz). This unit specifies the number of pulses per second that a given tone emits. The three standard Sampling frequencies are 44.1 kHz, 22.05 kHz and 11.025 kHz.

GIF (Graphics Interchange Format)

Raster graphics file format. Especially popular on CompuServe, Inc. (Columbus, OH.) and on bulletin boards throughout the country because it lets users create graphics line by line.

Gray scales

Color pictures can be broken down into gray scales. The gray tones are produced by varying the density of black pixels in printing. The greater the density of the pixels, the darker the picture appears.

Green Book

Definition of the standard for CD-I. This format is based on Mode 2 of the Yellow Book. In addition, 8 bytes are defined for a CD-I subheader. This standard also defines coding processes for various user data (Graphics, audio etc.).

Halftone image

This term refers to a black & white image with an infinite number of gray scales.

HDTV

(Acronym for High Definition Television) A standardized high resolution type of television transmission. The image is reproduced in motion picture format with an aspect ratio of 16:9.

High-Sierra-Standard

First definition of file recording format for CD ROMs (1985). Later became the ISO 9660 standard.

See also: ISO 9660

Hypertext

Unlike reading a text from beginning to end, hypertext gives you the option of moving around from cross-reference to cross-reference on different pages in the text and then returning to the original page. Hypertext applications are used for online Help systems and reference "book" applications.

Image Pack

Information unit on a Photo CD containing the hierarchy of components necessary for a single image. The size of an image pack can range between 3 Meg and 6 Meg.

Image resolution

The degree of resolution achieved by individual components is important for all graphic output, via the screen, printer or, e.g., a scanner. The greater the number of pixels used, the better the quality of the representation.

Interaction

The term interaction in general has to do with the mutual actions of several persons, and is often used in reference to software solutions. The program reacts to user input and the program flow continues in a certain direction, depending on the input. For example, in a tutorial program users can review or skip chapters depending on how well they answer test questions or solve practice exercises.

Interaction/Interactive Software

Software whose program flow can be controlled by the input of the user. Multimedia applications and tutorials are frequently interactive.

Interlace

Displaying an image using two half frames, one containing the even lines and the other containing the odd lines. Television and video use this process to achieve flicker-free playback with a lower number of images. This process is only suitable for animation. On a computer screen, which usually doesn't show much movement of images, the flickering can be irritating and tiresome.

Interleaving

Method of the CD ROM/XA standard in which different types of data, such as audio, video or computer data can be stored together in nested form. Different sequential sectors can be parts of different files.

Interrupt

(IRQ = Interrupt Request) Term for a signal sent to the CPU from a peripheral device so that a specific function of the device is carried out. A total of only seven hardware interrupts is available. If you use many different peripheral devices such as scanners, sound cards or overlay boards, make sure the interrupts don't conflict with each other.

ISA-Bus (Industry Standard Architecture)

Conventional CPU bus, allowing a maximum data transfer rate of approximately 7 Meg/s.

ISDN (Integrated Services Digital Network)

Developed by Telekom for better data communication. One possible development of ISDN is the video telephone.

ISO 9660

A Yellow Book standard for CD-ROM that describes the file system. This is a hierarchical file system like the one you are familiar with from your PC. The only differences or limitations have to do with the filenames. PCs only allow eight characters for the name and three characters for an extension. Amiga and Macintosh computers allow as many characters as you wish for filenames. To guarantee compatibility among the various computers, two levels were defined in the ISO 9660 Standard, Interchange Level 1, which accepts DOS conventions, and Interchange Level 2, which allows filenames of any length.

Special drivers are responsible for translating the file organization on a CD to the appropriate operating system. The program for MS-DOS is called MSCDEX.EXE.

Land

Elevation on a CD ROM for information coding.

Laserdisc

Laserdiscs contain video and audio data stored in analog format.

See also: CD-V

Lead in

The innermost 4 millimeters of a CD, immediately preceding the actual data. The lead in contains the table of contents of the CD.

Lead out

The conclusion of the data range on a CD. The lead out is located at the outer edge of the CD and is approximately 1 millimeter in width.

JPEG

(Acronym for Joint Photographic Expert Group) This body of experts recommended a standard for compressing digitized video color images that are to be saved as still video. Their standard allows for compression up to a ratio of 50:1 without a loss of quality.

Magneto-Optical Disk

This term refers to a magneto-optical disk in 5¬-inch format that can be written many times. Unlike conventional diskettes, the magneto-optical disk offers a much higher storage capacity.

Maximum Capacity

The maximum capacity of a CD ROM is 650 Meg (74 minute CD) or 554 Meg (63 minute CD)

MCI

(Acronym for Media Control Interface) Term for a manufacturer independent, cross-platform software interface. Microsoft and IBM collaborated in the development of MCI to create a standard for the use of multimedia hardware components such as sound cards, CD-ROM drives and overlay boards. For example, this standard is used to regulate data traffic to digital mass storage devices.

MIDI (Musical Instrument Digital Interface)

MIDI is a serial interface for connecting MIDI devices to each other and the PC. MIDI is a general standard in the field of electronic music.

MIDI Channel

MIDI manages up to 16 data channels, on which music signals from up to 16 connected instruments can be transported.

Mixed Mode CD

CD ROMs that contain audio tracks as well as data tracks. The data track always comes first, followed by the audio tracks.

Mode-1/Mode-2

The classic CD ROM standard has Mode-1 sectors and Mode-2 sectors. Mode-1 sectors are for data sensitive to error, such as programs and computer data, while Mode-2 sectors are for data less sensitive to errors.

With Mode-1, an extra 280 bytes are used for error detection and correction.

MPC (Multimedia PC)

Several companies, including Microsoft and the MPC Counsel, outlined minimum requirements for a multimedia PC systems. The practical side of the MPC definition is that there are MPC software programs that only run properly on PCs that meet the MPC standard.

In the first level of MPC in 1989, the requirements were modest, while the current level, Level 2, has higher requirements. According to the current level, not every PC with a sound card and CD ROM drive is an MPC computer.

MPEG (Moving Picture Expert Group)

MPEG is a hardware supported compression method for video sequences that has already developed into an important standard.

MSCDEX.EXE

High-Level driver for CD ROM drives that you link to the AUTOEXEC.BAT file.

MSD (Microsoft Diagnostics)

Program supplied with MS-DOS and Windows which displays a great many system parameters, especially the interrupts, I/O base addresses and DMA channels.

To call the program, enter MSD from DOS or the Windows environment.

Multi-CD-ROM

A crossplatform CD developed by Sony for the DOS/Windows and Apple Macintosh operating systems.

See also: Crossplatform-CD

Multimedia

Multimedia as applied to PCs is the integration (combination) of different media, such as text, graphics, video, animation and sound.

See also: Interaction

Multimedia Upgrade Kit

A complete package for multimedia usually consisting of a CD ROM drive, a sound card and active speakers. With a multimedia upgrade kit you can upgrade a conventional PC to a multimedia PC from one source.

Multiple session

A feature of CD ROM drives that makes it possible to read CD-Rs that have been recorded in more than one pass (session).

See also: Singlesession

NTSC

(Acronym for National Television System Committee) The American television standard, which works with 525 lines and 30 frames per second.

Orange Book

The Orange Book contains the specifications for recordable CDs.

Overlay Card

Installing an overlay card in your PC makes it possible to capture NTSC video signals into a VGA image. The video signal is digitized and reproduced on the computer screen in real time.

PAL (Phase Alternate Line)

PAL is the television standard for most countries outside of the USA and Japan. PAL works with 625 line resolution and a frequency of 50 Hz (50 half frames per second).

PCI-Bus

CPU bus standard that supports much higher data transfer rates than previous systems. The PCI bus has data transfer rates up to 132 Meg/s and allows easy installation of add-on cards.

See also: CPU-Bus

PCM (Pulse Code Modulation)

Standard procedure for digitizing audio data.

Palette

A palette is a color group from which the color display of an image or graphic is taken. Each palette entry describes a color. Each pixel of the graphic is assigned an entry from the palette. The number of colors that can be displayed at the same time is limited to the number of entries in the palette.

When a graphic is imported to a program that works with a different color palette, any original colors not included in this palette are either deleted or replaced.

Pantone

To be able to produce clearly defined colors, American companies developed a color scale that contains approximately 150 labeled colors. A fixed mixing ratio of primary colors is defined for these colors.

PCX format

The most widely used format for pixel graphics is PCX format, which was developed by ZSoft for their Paintbrush program. While PCX format can be read by almost all (especially Windows) programs; this advantage is offset for professional image processors by the fact that a TrueColor display with resolutions of more than 1024 x 768 pixels is not possible. An 8 bit display is the maximum. In spite of that, PCX format has established itself as the PC standard.

Photo CD

The Photo CD was developed by Eastman Kodak Co. (Rochester, NY). A Photo CD contains digitized color negative and positive films that can even be edited with the proper software and hardware equipment.

Photo CD drive

A Photo CD drive must fulfill the XA specifications, in particular, it has to be able to read XA sector format. It also must be multisession capable.

See also: Photo CD, Multiple session

Pit

Indentation on a CD ROM for information coding purposes. Pits are between 0.833 and 3.56 thousandths of a millimeter in length and 0.6 thousands of a millimeter in width.

Pixel

Picture element; represents the smallest displayable unit of a computer image, as they can be reproduced by output devices (monitors, printers, etc.).

PLV

(Acronym for Production Level Video) Process for digitizing live video in real time. In the PLV process, digitizing takes place at a resolution of 256 x 240 dots. Because of this resolution, recorded live video can be displayed in full-screen mode without sacrificing quality.

POI (Point of Information)

Terminal from which an information system can be interactively operated.

POS (Point of Sale)

Terminal that lets you call up information and place orders in a retail sales environment.

PostScript

Refers to a standardized page description language in which graphical information is represented by a command set. A Postscript file is converted to printer output by a special Postscript interpreter inside the printer. Postscript has established itself as a widespread standard and is supported by nearly all software applications.

Presentation

A presentation is an audio-visual demonstration of a product or subject. Multimedia components such as animation and acoustical accompaniment are important aids in delivering the presentation.

Quatro-Speed drives/Quad-Speed drives

Drives that work with quadruple rotation speed. The data transfer rate for such a drive is around 600K/s.

Real Time Operation

Refers to the processing of a MIDI or video signal in real time, that is, without delay.

Red Book

Definition of the standard for audio CDs. A sector contains 2352 bytes of useful data. In addition, 784 bytes are required for error identification and 98 bytes are needed for management.

Rendering

To produce realistic three-dimensional animations, it is necessary to move complex three-dimensional objects through virtual space. The computer calculates the buffer images for you with the necessary software. This process is referred to as rendering.

Resolution

Used in conjunction with graphic cards, scanners or printers, the term resolution refers to the dithering of an image into single picture points, called pixels. The greater the number of pixels used per area unit, the higher the quality of the displayed image. Since resolution normally varies in horizontal and vertical direction, the resolution for both directions is specified per length unit.

Rotation speed

Because of the information structure on the CD, the rotation speed changes constantly. Each sector is part of a long track leading from the inside of the CD to its outer edge, and each sector on a track is of the same length. Since each sector must be read at the same speed - the read head on a standard CD ROM can use exactly 1/75 of a second - the rotation speed inside the CD surface is less than outside. On the inside the speed is about 200 revolutions/second, on the outer edge its 500 revolutions/second.

RGB

Refers to the three primary colors of red, green and blue. On RGB monitors, colors are produced from the proportion of primary colors in the mixture according to additive color mixture. The term refers to a composite color signal. There are RGB analog signals and RGB TTL signals, depending on whether you are dealing with analog or digital image signals.

RLE

(Acronym for Run Length Encoding) A data compression process in which redundant sequential values are combined into data blocks containing the value and frequency.

RTV

(Acronym for Real Time Video) Digitizing process for live video in real time. The RTV process uses a maximum resolution of 128 x 120 pixels. All irrelevant information about the image is suppressed. Because of their low resolution, video sequences stored by the RTV process should be displayed only in small windows. See also PLV.

Sampling

Sampling refers to the digitizing of audible sounds, speech and noise. The quality of the sampled file is determined by the depth of the scanning and the scanning frequency.

Sampling depth

Sampling depth has to do with the digitizing of analog signals, it specifies the number of values available for coding. Sampling depth is specified in bits. 4 bit corresponds to 16 different values, 8 bit corresponds to 256, 16 bit corresponds to 65536.

See also: Scan rate, Sampling

Scan rate

How often an analog input signal is measured in order to assign it digital values. When analog audio signals are digitized (sampling), the usual scan rate or scan frequency ranges between 11.025 kHz (11025 times per second) and 44.4 kHz (44 400 times per second).

See also: Scan depth, Sampling

Scanning frequency

Scanning frequency describes the speed with which monitors are able to illuminate video sequences of single frames on the screen. The frequency is measured in Hertz.

Good computer monitors work with frequencies of 70 Hz and above.

SCSI

(Acronym for Small Computer System Interface) Standardized interface for various devices such as hard drives, scanners, CD-ROM drives etc. You can connect as many as seven devices to a controller.

Because it's possible to hook up different end devices to a SCSI controller like hard drives, CD-ROM drives, scanners etc., you need a different driver for each device. Data is transferred at 9 bit width (8 data bits and one stop bit). SCSI interfaces can be operated both in serial and parallel operation. Data transfer occurs in blocks.

Sector

A sector is the smallest data unit that can be read from an external memory. On a CD ROM, sectors are 3234 bytes. This includes 784 bytes for error detection and correction. The organization of the remaining bytes varies depending on the CD format.

Sequencer

A sequencer is a program that is able to reproduce MIDI signals. The MIDI signals can be entered by hand, from a file or from a MIDI device.

Single session

A number of older CD ROM drives are single session drives, because they can only access data from the first session, that is, data stored in the first recording session.

See also: Multiple session

Sound Blaster

Creative Labs Inc. (CA), came out with version 1.0 of this sound card in 1989. SoundBlaster cards are the most popular sound boards and is the sound standard today for PCs and MPCs.

Sound card

Card installed in PCs, usually equipped with various interfaces. For example, there is an interface for outputting digital sound signals as audio signals.

See also: Adlib, Sound Blaster

Synthesizer

Device for electronic sound production. You can generate sounds by producing electric oscillations (FM synthesis) or imitate the sounds of real musical instruments through sampled sounds.

See also: FM Synthesis

TGA format

TGA format is a graphic format that allows saving and conversion of true color graphics between PC and Macintosh. The US uses this format more than other parts of the world.

Thumbnail

A small version of an image. Many image processing programs let you preview images in thumbnail size before opening them for processing.

TIF format

(Acronym for Tagged Image File Format) TIF (also called TIFF) format is a frequently used graphic file format. The big disadvantage to TIF lies in the many different versions of TIF that exist - there is no one "true" TIF format. Uncompressed TIF files require large amounts of memory, so a compression option exists. However, some programs do not support compressed TIF images.

TOC (Table of Contents)

Table of contents on a CD. The TOC is always in the lead area of the CD.

Touch Screen

Touch screen refers to monitors that allow you to input commands by touching specific areas on the screen.

TrueColor

Representation of a graphic in true to life colors. The color depths are 24 bit, approximately 16.7 million different colors are possible.

Twain

Program interface that a graphic program can activate an image capturing peripheral.

Vector graphics

These graphics are defined using vectors rather than pixels. For example, a line definition consists of the starting point, ending point, and the line thickness. An enclosed object would include the type of fill. Vector graphics are easily resized without degeneration of the image.

VHS

Frequently used video format. Most home VCRs are VHS.

Video

General term for conveying visual information.

Video signal

A video signal passes visual information using electronic means, from a video recorder or a video camera. Television stations transmit video signals for you to view on your TV at home. Many different types of video signals exist: NTSC, PAL and SECAM. Information can also be generated as a composite signal (sometimes called FBAS).

Videodisc

Videodiscs contain a great deal of graphic information (e.g., IBM tutorials) because they have such a high memory volume. Videodisc players also provide direct access anywhere on the disc. Video data is recorded in analog format and sound is recorded in digital format.

Virtual Reality

Computer generated reality that can interact with all the senses. Usually a glove and goggles are used so that the user can experience three-dimensional interaction with the computer.

VOC

DOS format for sound files.

WAV

Format for WAVE files, which are Windows sound files.

Wave Tables

A collection of sampled sounds stored in a sound card.

White Noise

Test signal made up of all audio ranges.

WORM

(Acronym for Write Once Read Many) Unlike the standard CD-ROM, WORM lets you write to a CD just once. This is useful for archiving data (e.g., registration information) for later recall.

XA

(Abbreviation for Extended Architecture) A new standard stated in the Yellow Book. The most important factor in XA is the coexistence of music, video and graphic data between tracks on a CD. The XA standard basically follows the Mode 2 sectors of CD-ROM standards. XA standard offers two types of program data in Mode 2 - Mode 2 Form 1 and Mode 2 Form 2. An eight-byte subheader indicates the use of each form.

YCC Color system

Kodak-defined standard for displaying True Color graphics from binary formats. This color system uses the RGB color scheme (eight bits for each primary color), within the components chrominance and luminance, similar to YUV coding. Photo CD pictures use YCC color coding.

This 24-bit system divides each color pixel into two components: Eight bits of luminance (256 degrees of brilliance), and eight bits of chrominance (the color components). These components ensure optimal display of natural color. Critical colors (e.g., red) have more color hues available than others (e.g., dark blue).

Yellow Book

Based on the Red Book (audio CD standards). This standard has two modes, which distinguish between error checking and maximum data transfer rate.

Mode 1: One sector contains only 2048 bytes of usable data, with 280 bytes reserved for additional error correction. This format requires 12 synchronization byes and four header bytes, above and beyond the number stated in the Red Book, for data handling.

Unlike audio CDs, every single sector must be accessible in a data CD. Therefore, the 12 synchronization bytes are used to access the number of each sector, as stored in the four header bytes. This permits fast access to each sector.

As this standard is based on the Red Book, 784 bytes are reserved for normal error checking, as well as 98 bytes for processing in a sector.

A statistical algorithm can restore the 280 bytes used for additional error correction to the total usable data, when only a small part of the usable data can be properly read. This generates the odds of finding one read error within 1000 Gigabytes.

Mode 2: This mode permits accelerated reading speed as well as additional error correction. In this case, only the 12 synchronization bytes and four header bytes are required from the 2352 bytes of usable data (this specified by Yellow Book specification), leaving 2336 bytes. The bottom line is a maximum data transfer rate of 171K per second (75*2336). The odds of errors occurring are slightly higher.

YUV

Abbreviation for a video signal based on brightness and color. YUV follows VHS conventions.

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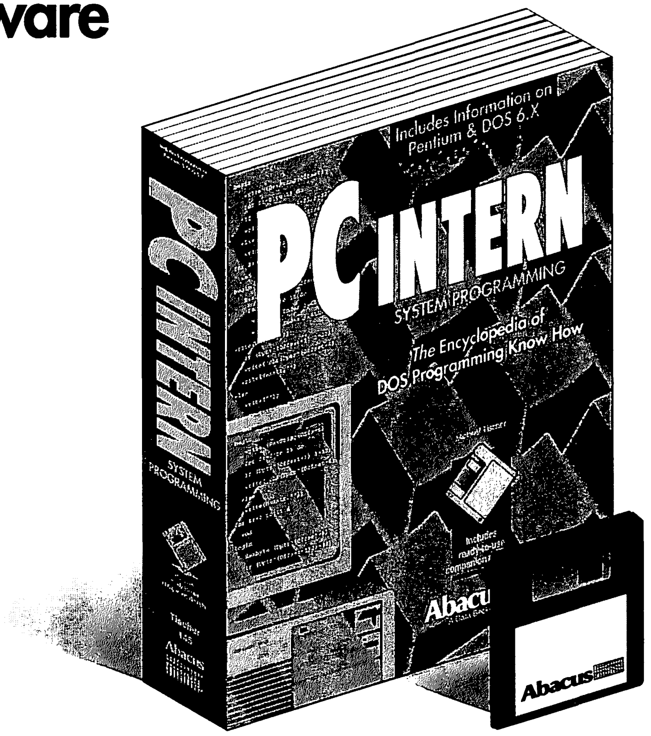

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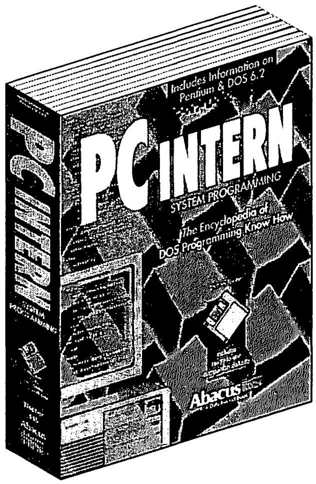

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Multimedia Presentation

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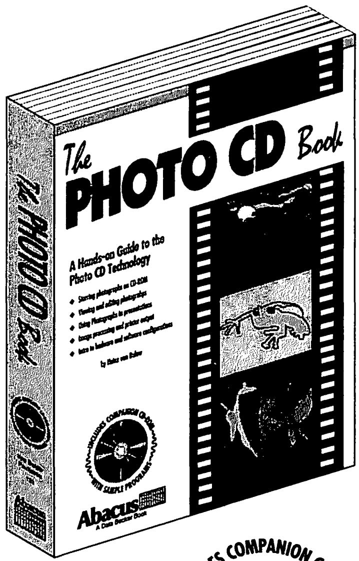

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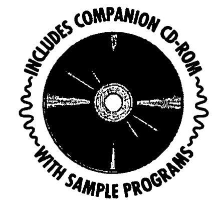

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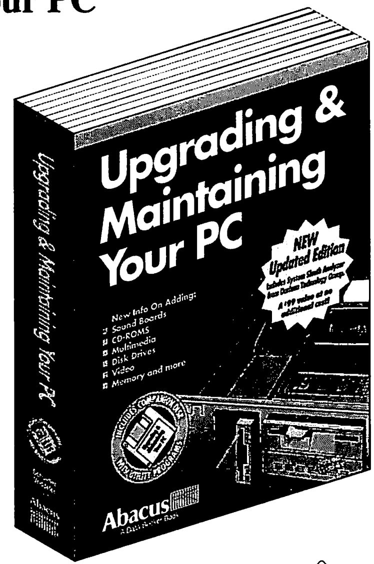

This bestseller is new and improved for '94. This third edition of **Upgrading & Maintaining Your PC** shows even the novice explains how all the parts work together. They'll how to add a new hard drive, additional memory, a SCSI interface, an enhanced processor chip, or a complete multimedia system. As the technology changes, we've updated this book for some of the newest equipment including Intel's new Pentium processor, ink jet printers such as the HP DeskJet 500, 550C and 300 printers, DOS 6.0 and 6.2, CD including the new Photo CD technology.

Other topics covered:
- New 2-speed CD-ROM drives
- MPC level 2 specifications
- ASP16 Sound Blaster and 16-bit sound cards
- SVGA monitor information
- Windows for Workgroups
- Windows NT ans OS/2 V2.1

Companion diskette contains several essential diagnostic and troubleshooting utilities including System Sleuth Analyzer, PCINFO, HDTEST, FIXDSK and others.

Authors: H. Veddeler & U. Schueller
Order Item:#B253
ISBN: 1-55755-253-3
Suggested retail price: $34.95 US / $44.95 CAN with companion diskette

To order direct call Toll Free 1-800-451-4319

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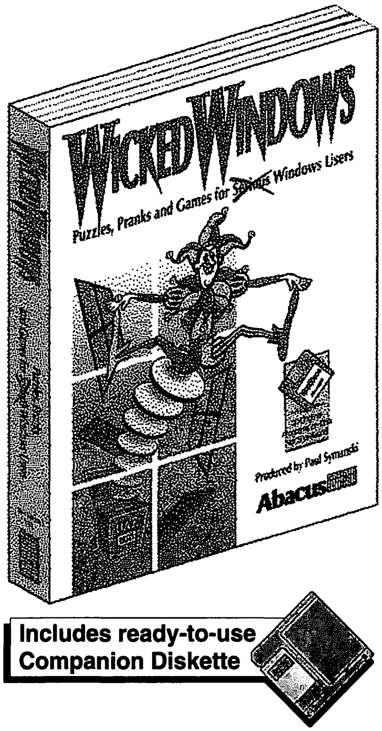
Wicked Windows Comes Alive

is a multimedia screen saver that tells a complete story in the form of an animated cartoon with sound, action and dialogue. The automated message feature allows you to import sound files to the animation and create your own personal audible communication.



Alive also allows you to create custom multimedia screen savers by importing animation from any *Autodesk* animator program.

Highlights:

- ◆ Multimedia screen savers created by experienced animation and graphic specialists.
- ◆ Includes the story of "Wendell" in an animated screen saver.
- ◆ Create individual multimedia screen savers easily with the help of an animation program.
- ◆ Learn how to utilize *Autodesk Animator*, *Autodesk Animator Pro* and *Autodesk 3D Studio*.

Author(s): S. Schlomer & A. Gulich
Order Item: #B186
ISBN: 1-55755-186-3
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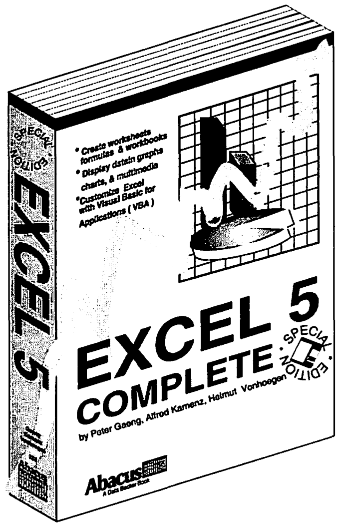
Easy Learning for Everyone

Excel 5 Complete



Excel 5 Complete is the latest release in our "Complete" user guide series. Our "Complete" books have earned a reputation among end-users as being thorough, informative, and easy to learn from — for beginners through advanced level computer users — and this book is no exception.

The new version of Microsoft's Excel, version 5, sets new standards in functionality and user-friendliness. **Excel 5 Complete** covers the full functional spectrum of this widely used spreadsheet program, with special emphasis on the new features in version 5.

Beginners and users upgrading from previous versions of Excel will learn from the introductory chapter in which new features, fundamentals, and special aspects of Excel 5 are introduced in an easy-to-understand manner. From there, the user is led, step-by-step, into creating a spreadsheet, the use of the new pivot views, working with formulas, and the diverse opportunities for using data exchange.

A special concentration is on the graphical representation of values in the form of tables or complete presentations (including multimedia). The new database functions are also introduced, as are the fantastic options available with object-oriented data exchange through OLE 2.0 (object linking and embedding).

Other subjects covered include:

- ◆ Using macros
- ◆ Introduction to VBA programming language (Visual Basic for Applications)
- ◆ Example oriented function reference.
- ◆ Companion diskette with all of the example applications from the book

Authors: Peter Gaeng, Alfred Kamenz & HelmutVonhoegen
Order Item: #B252
ISBN: 1-55755-252-5
Suggested retail price: $34.95 US / $44.95 CAN with companion disk

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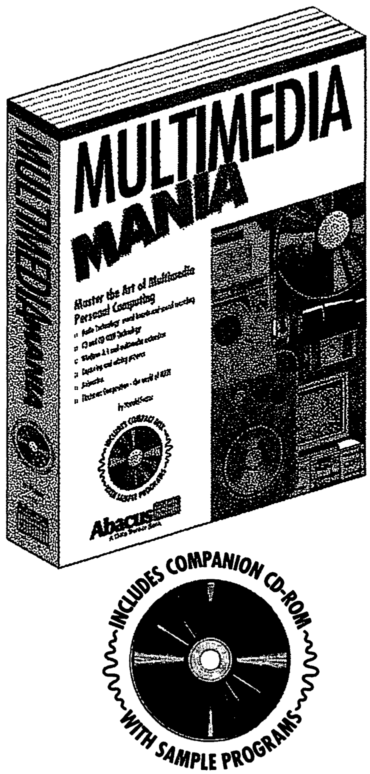
Multimedia Presentation

Multimedia Mania

explores the evolving multimedia explosion. This book begins by explaining what the term multimedia means, continues with valuable information necessary for setting up a complete multimedia system, then provides instructions on creating multimedia presentations. **Multimedia Mania** also includes information about popular multimedia programs.

Multimedia Mania will guide you through workshops helping you develop professional presentations. The companion CD-ROM contains example programs and samples of techniques discussed in the book allowing you to gain practical experience working with multimedia.



Multimedia Mania also covers:

- Audio Technology: sound boards and sound recording
- CD and CD-ROM technology
- Windows 3.1 and its impact on multimedia
- Capturing and editing pictures
- Animation techniques
- Electronic Composition - the world of MIDI

Author: H. Frater & D. Paulissen
Order Item: #B166
ISBN: 1-55755-166-9
Suggested retail price: $49.95 US/ $64.95 CAN with companion CD-ROM

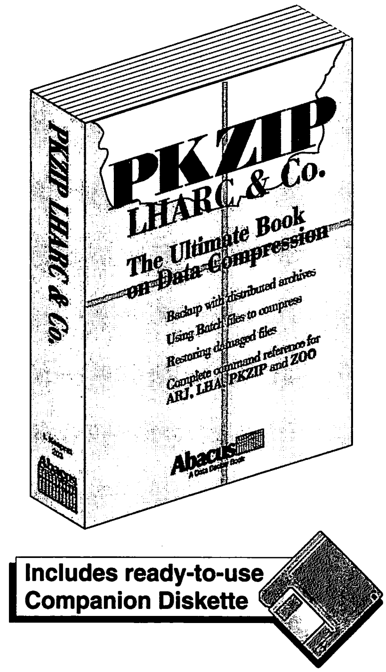
To order direct call Toll Free 1-800-451-4319

In US and Canada add $5.00 shipping and handling. Foreign orders add $13.00 per item.
Michigan residents add 6% sales tax.

Productivity Series books are for users who want to become more productive with their PCs.

PKZIP, LHARC & Co.

Did you ever notice that you always seem to run out of space on your hard drive at the least opportune time? Luckily, there are ways to increase a computer's storage capacity with data compression. Several FREE and LOW-COST shareware utilities like PKZIP, LHARC, and ZOO are available for the asking.



PKZIP, LHARC & Co. shows you how to take advantage of the space-saving features that each utility offers. Not only will you learn how data compression works, but you'll find out how to take advantage of the hidden features of these valuable utilities: sharing files; automatically running compressed programs; protecting files with passwords; adding comments and notes to compressed files and much more.

You'll also learn about:

- Backing up and sharing compressed files
- Simplifying the job with batch files
- Restoring damaged archives
- Adding comments to your files
- Executable compression programs: LZEXE, PKLite and Diet
- File Compression programs: PKZIP version 2.04g, LHARC, ARJ and ZOO

The companion disk includes valuable data compression programs discussed in the book.

Author: Istok Kespret
Order Item: #B203
ISBN: 1-55755-203-7
Suggested retail price: $19.95 US/ $25.95 CAN with companion diskette

To order direct call Toll Free 1-800-451-4319

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The Directories On The Companion CD-ROM

ANIMATIO	This directory contains all the 'killer' NITRO animations.
CACHE	This directory contains the Hyperware Speedkit files.
CDCHECK	This directory contains the CDCHECK diagnostic program.
GRAPHIC	This directory contains the Graphic WorkShop for Windows (GWSWIN); PaintShop Pro (PSP) and Photo Show 3-D (WINVIEW)
MULTIMED	This directory contains VIDVUE, VIDVUE is a Multimedia player/slideshow utility and image viewer/utility.
PIC	This directory contains the bitmap images of the animations for NITRO.
SOUND	This directory contains the CD-PLAYER (CDPLAY); Gold Wave (GOLDWAV); Windows Sound Sculptor (WMSCULP) and WAV which contains dozens of sample wave files.
VHELP	This directory contains sound waves used in NITRO 'KILLER' ANIMATION.
VIDEO	This directory contains an animation player and more sample animations (ANIMAT); A collection of 'avi' animation files (AVI); Photo Morph 2.0 demonstration software (MORPH); Microsoft's Video for Windows runtime module (VFW); and AutoDesk's Windows Animation Player (WINPLAY)
SONY	This directory contains a movie depicting CD-ROM production.
DRIVERS	This directory contains the video player drivers.

To start the CD, type:

MENU

and press Enter.


CD-ROM!
The Naked Truth & Killer Animations
Tracks 2-12:
Audio Tracks
Type MENU
Press <enter>
to start CD!
CD-ROM! The Naked Truth & Killer Animations
ISBN 1-55755-266-5
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5370 52nd Street SE
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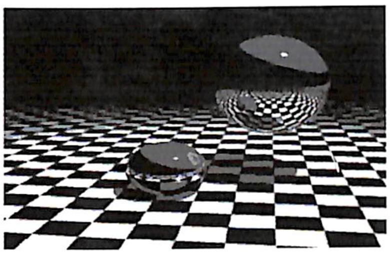
CD-ROM!

The Naked Truth & Killer Animations

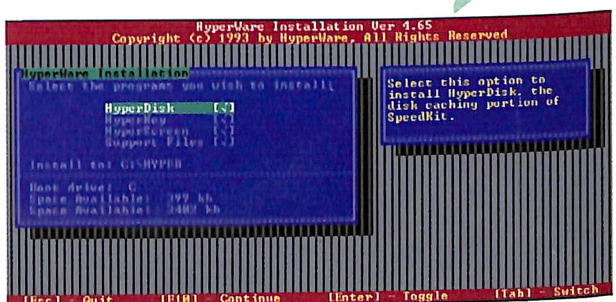
CD-ROM! The Naked Truth and Killer Animations is a valuable, "all-in-one" product for the CD-ROM, multimedia enthusiast. A book about CD-ROM technology with a ton of software to supercharge your drive and titillate your imagination.



Inside you'll walk through the nitty-gritty of CD-ROM technology and into the wild side of virtual landscapes and 3D animations. Nothing is sacred; everything exposed. You'll learn all about correct CD-ROM installation, hardware configuration, and how to optimize and tune your computer system for the best performance.

Complete with software utilities like

CDCheck, you'll be able to check and test the performance of your CD-ROM drive - speed, access and transfer rate. Speed is what it's all about. Faster is better. On the companion CD-ROM, you'll find special speed programs from HyperWare - HyperDisk, HyperKey and HyperScreen - all programs that help you juice your drive and multimedia system.



Includes Companion CD-ROM

Computer Book Category

IBM/PC: CD-ROM Hardware

Level: Beginner/ Intermediate/ Advanced

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